

SCIENCE.

FRIDAY, FEBRUARY 1, 1884.

COMMENT AND CRITICISM.

As it has now been determined that the Greely relief expedition of 1884 shall be placed in the hands of naval officers, and that suitable vessels shall be purchased for the purpose, it is perhaps advisable to remind those interested of certain essential features of the task before us. It is desirable, that, whatever plans be adopted, it be distinctly remembered that the object of the expedition is to relieve Greely and his men; that it is essential to success that training and brains should lead the expedition, and that a mere naval training is not a sufficient qualification without experience in ice-navigation; that the praiseworthy ambition common to the best naval officers does not fit them for such technical work, any more than it would to write an epic poem; and, lastly, that qualified men may be had, and should be engaged, even if not nominally in command, and their advice should have controlling weight.

We pointed out some time since, that the responsibility for failure would be laid where it belongs, by the public, regardless of official pride or red tape. That brave men should perish because points of precedence cannot otherwise be comfortably settled, is unendurable. It is probably better that only one branch of the service should be concerned in the expedition. That this was not the case in 1883 is generally (whether rightly or not) supposed to have some connection with the *fiasco* which is now a matter of history. Apart from that, there is little doubt that Capt. Pike felt his judgment of the propriety of pushing into the ice overruled by the officer in charge, whether that officer was conscious of his influence or not. In the present expedition not the smallest loophole should be left for any such proceeding, or it is predestined to failure.

No. 52.—1884.

It is most unfortunate that at the present time we have probably not a single ranking officer in the navy of experience in the sort of navigation the expedition must necessarily encounter. However, since it is the case, it should be recognized in the organization of the expedition; and, if any doubt exist as to the willingness of the naval authorities to provide for the deficiency by availing themselves of technical knowledge outside of the service, a mandatory clause to this effect might well be inserted in the act of Congress providing for the expedition. It may be thought that we reckon too lightly the effect of the grave responsibility which will fall on the officers who may be selected; but the record of the two previous expeditions for the same purpose is a sufficient warranty for reasonable scepticism.

IN order to secure to the fullest extent the unusual advantage arising from the coincidence in the time of holding the proposed International electrical exhibition in Philadelphia, and of the meeting of the American association for the advancement of science in the same city, in connection with the anticipated visit of the members of the British association to that city, the Franklin institute has appointed a special committee to confer with scientific men as to the best method to be adopted for securing, during the month of September, the assembling at Philadelphia of a conference of electricians. To defray the expenses of such a conference, a bill has been prepared, asking for a small appropriation from Congress. Scientific men interested in this measure are earnestly requested to give it all the aid in their power. Communications on the subject are respectfully requested by the committee, consisting of M. B. Snyder, Edwin J. Houston, William H. Wahl, W. P. Tatham.

ONE cannot fail, while reading books of travel, to note the poverty of geographic terminology.

Even those explorers who attempt to describe closely what they see are hampered by the lack of terms of precise meaning with which to name the elements of a landscape; for, apart from the rarity of teaching in this important branch of physical geography, there is too little recognition of the connection that necessarily and often clearly exists between internal structure and external form, — too great neglect of the evolution of topography, during which the features of youth, maturity, and old age, succeed one another. There should be a terminology as well defined and extensive as that which botanists have invented for the description of leaves; for it is about as indefinite to call a country hilly as to call a plant leafy. There should be a collection of typical forms in models or figures marked with descriptive terms, approved by some authoritative body, to serve as a standard by which travellers might be trained. The question is well worthy the attention of geographic societies and congresses.

It is much to be regretted that it has been found necessary to suspend the operations of the Northern transcontinental survey. It was organized about two years ago, under the direction of Mr. Raphael Pumpelly, to obtain a comprehensive and authoritative knowledge of the resources of the vast region in the north-western part of our country tributary to the Northern Pacific railroad and the associated companies, at whose cost it was undertaken. Up to that time this extensive territory, embracing, perhaps, one-fifth of the United States, had been very imperfectly explored geographically, and was still less known as regards those resources which will contribute to the business of the railroads that traverse it. A large amount of accurate information has now been gathered, and in small part published. Mr. A. D. Wilson, of broad experience in western exploration, was put in charge of the topographical work, with Messrs. Goode and Nell as chief aids; and we have just received a set of six maps, the fruit of their first season's surveys, a notice of which will be found in the 'Notes and news.'

FROM a circular just issued by Professor Dohrn, we learn that the cost of publishing the *Zoologischer jahresbericht* for 1879 and 1880 amounted to nearly \$7,000, while the income from sales of the publication amounted to only \$2,317. The zoölogical station at Naples has thus been obliged to meet a large deficit, amounting to at least two-thirds of the cost of publication. It is plainly not within the means of the station to continue indefinitely this work without assistance. The governments of Italy, Germany, and Russia, as well as one or two zoölogical societies of Holland, have made subventions which cover about one-third of the deficit. The three volumes of this work already completed speak for themselves. Every naturalist will learn with regret that a work of such general usefulness is in danger of being discontinued from the cause above named. We certainly hope that Professor Dohrn's appeal for assistance will meet with a liberal response, both in the way of subscriptions for the *Jahresbericht* and in subventions.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Earthquake waves at San Francisco.

ASSISTANT George Davidson telegraphs the superintendent of the U. S. coast and geodetic survey from San Francisco, that at 7 h. 24 m., last evening, earthquake waves were indicated by the delicate levels of the astronomical instruments of the observatory. The amplitude of each vibration was three seconds of arc, in three seconds of time, and they continued for twenty minutes.

C. O. BOUTELLE,

Assist. in charge of office, etc.

Coast and geodetic survey office,
Jan. 26, 1884.

Influence of winds on tree-growth.

I notice at p. 471 of the issue of *Science* for Oct. 5 some remarks by Mr. W. S. Kennedy on the influence of winds on tree-growth. It may be of interest to learn that many of the trees on the seashore at Government House, Malabar Point, Bombay, are bent landward from the effect of the prevailing sea-breeze.

H. RIVETT-CARNAC.

Allahabad, N. W. P., India,
Dec. 8, 1883.

Some curious natural snowballs.

On p. 237, vol. i., of *Science*, under notes and news, is a reference to some curious snowballs noticed in *Scientific American* for March 17. Such an exhibition I lately saw; and it may interest readers of *Science* to know the conditions favoring such a phenomenon.

On Jan. 8 and 9 some thirty inches of snow fell in this region, followed by warmer weather and light rain on the night of the 10th, settling the snow into a

compact mass. On the 11th and 12th came freezing weather, and the fall of a small amount of very light snow. On the 13th the thermometer, toward noon, rose above freezing-point, with a stiff breeze from the south. This wind so acted on the surface-particles of the upper layer of uncompacted snow as to set some of them in motion. Each particle thus set in motion, owing to the soft condition of the surface-snow, formed a nucleus, which, as it proceeded, forced along by the wind, gathered the contiguous portion of the soft layer, and assumed the form of a cylinder, with a conical cavity at each end, and having a length about twice as great as its diameter. The size depended upon the inclination and smoothness of the surface traversed. The largest cylinders I saw were about three feet long, at which limit they acquired sufficient weight to indent the frozen surface of the under or main body of the snow. This, of course, stopped the further rolling of the mass. The only locality where they acquired the above large size was where the surface had a slight inclination to the north; and the snow was deep enough to cover all weeds, leaving a perfectly uniform and smooth surface for their formation. In many cases the balls were rolled up an inclination of as much as one foot in ten, when exposed to the unbroken force of the wind; but those thus formed acquired weight sufficient to resist the pressure of the wind, when about six inches in diameter. When the surface inclined toward or directly away from the wind, the balls traversed a straight path; but, when the surface declined to the north-east or north-west, the path was a curve; at its initial, approximately straight; but, as the ball acquired weight, its direction was a compromise between that required by gravity and that by the direction of the wind, until, in some cases, the ball obeyed gravity alone. The most curious part of the display was the abundance of the balls. While travelling three miles, I saw what I estimated at over a hundred acres dotted more or less thickly with the cylinders. In some cases there were twenty-five balls to the square rod; in others, only two or three; averaging, perhaps, eight or ten. I saw multitudes in the process of formation, which was as sudden as a flash; but they almost immediately assumed a slow rate of motion, about that of a mole taking his leisurely walk. In a few cases the cylinders would stop, and afterward be forced into motion again. The largest examples required for their formation the traversing of from two to three rods. SAM HUSTON.

Richmond, O., Jan. 16, 1884.

The wind performed a very pretty feat in some portions of northern Ohio on the morning of Jan. 13. Loose bits of snow were caught up as a nucleus, and rolled along upon the surface until balls of considerable size and peculiar shape were formed. The whole surface was strewn with the balls; but they were most abundant upon lawns and fields where the wind was not obstructed, every square yard, in some places, bearing a ball of greater or less size. The largest observed here were upon the college ball-grounds, where they reached ten inches in height, and a horizontal length of eighteen inches. Even these were swaying as the gusts passed over them; and their tapering track could be plainly traced back towards the south-west, twenty-five or thirty feet, to the apex where they started. Their shape was cylindrical, deeply hollowed at both ends, so that they looked like 'muffs,' and the spiral formed by the successive layers was finely regular and distinct.

The meteorological conditions which made the phe-

nomenon possible were as follows. Two days before the occurrence a slight crust was formed upon the snow. On the following day an inch of light flaky snow fell upon this crust. Then followed the warm south-west wind on the morning of the 13th, which brought the upper layer of snow into the adhesive state, and rolled the balls before the crust was weakened; the crust sustaining the balls, and keeping them up to the wind, and at the same time furnishing a smooth floor upon which they could be propelled. The nuclei of the balls were obtained from chance foot-tracks, walk-borders, lumps blown from trees, etc., though often it was difficult to account for them. The balls were most abundant and perfect at about nine o'clock A.M. Before noon the crust had been attacked, and all sunk to rounded, insignificant clumps.

Oberlin, O.

ALBERT A. WRIGHT.

[Similar snow-rolls were seen at Sharpsville, Mercer county, Penn., on the same day, by J. M. Goodwin.]

Halos round the moon.

On the evening of Jan. 12, at 9.20 (90th meridian time), my attention was called to a peculiar appearance about the moon. The sky was quite clear at the time, and there appeared around the moon several colored circular bands. The first was of a bright silver-gray shade, and about two diameters of the moon in width. The next was yellow, the next faint orange, and the next violet. The three bands were each about one-half a diameter in width. The outermost band was of a green shade, and about two diameters in width. At ten o'clock the innermost light band remained, but all the others had been replaced by a blue band lighter than the surrounding sky.

H. A. HUSTON.

Lafayette, Ind., Jan. 14, 1884.

Explorations in Guatemala.

Looking over the back numbers of your esteemed journal, I came across a slight error. In the article 'Lorillard City' it is said (ii. 412), "M. Charnay found the ruins of an ancient city, which he named after his generous patron. In his exploration here, he was assisted by a young Englishman, Mr. Alfred Maudslay, with whom he shares the honor of discovery," etc.

Neither Mr. Maudslay, who arrived at these ruins before Mr. Charnay, nor the latter, can claim this honor. In fact, Mr. Maudslay distinctly states (p. 196 of the *Proc. roy. geogr. soc.*, April, 1883) that they have been discovered by Mr. Edwin Rockstroh, tutor on the Lyceo nacional at Guatemala City. This gentleman made, during the first half of 1881, a geographical and archeological exploration in the northern and western parts of the republic, visiting Tikal, and navigating the Río de la Pasión, Río de las Salinas, Río de los Gacandones, and the Usumasinta as far down as the ruins mentioned. He sent a short account of this voyage to Petermann's *Mittheilungen* (1881, p. 396).

In that account Mr. Rockstroh mentioned particularly the building described by Mr. Maudslay on p. 198 of the geographical society's proceedings; and (1882, on p. 435) he clearly states that Charnay's 'Lorillard City' is the same as that discovered by him in 1881. Mr. Rockstroh mentioned in his first letter to the *Mittheilungen* (July 19, 1881), that the Gacandones call these ruins 'Menche,' and promised in his last notice (1882, p. 435) an explanation of this name. I am not aware that he has furnished one.

I find in the 'Historia de la provincia de San Vicente de Chiapa y Guatemala,' by Antonio de

Remesal (Madrid, 1619), libro xi., cap. xviii.-xx., pp. 720-733, a province 'el Manché' mentioned as one of the provinces of Vera Paz, the Indians of which were converted in the years 1603 and 1604. Mr. Maudslay's map contains the Rio del Manché, an eastern tributary of the Rio Sta. Isabel, which latter, in its lower course, is called Rio de la Pasion. The province of Manché must evidently have been situated on the river of the same name, to the north of the village Cahabon, which was the starting-point of the Padres for their trip of conversion, as Remesal states.

Whether the name of this province, 'Manché,' has any connection with the word 'Menche,' as Mr. Rockstroh says the ruins on the Usumacinta (separated by a mountain chain from the central part of the Peten district) have, remains to be seen.

In regard to the notice in the same number and on the same page of *Science*, 'Explorations in Guatemala,' I beg to add, that the ruins of Tikal had been discovered in February, 1848, by Mr. Modesto Mendez, corregidor of the district of Peten, and by the gobernador Ambrosio Tut. Mr. Hesse, minister of Prussia in Central America, published the report of Mr. Mendez, dated March 8, 1848, in vol. i. of the 'Zeitschrift für allgemeine erdkunde' (Berlin, 1853, pp. 162-168), and added some general remarks, and two plates which he had carefully copied from Mr. Mendez's drawings. These plates contain the illustrations of four sculptures (in wood) and five monoliths discovered by Mr. Mendez in Tikal, and those of four monoliths discovered by him in Dolores, — another town with ruins, to the south of Tikal, in the same district of Peten. The chairman of the Royal geographical society is therefore mistaken in stating (p. 203 of the Proceedings) that the ruins of Tikal were described for the first time by Mr. Maudslay.

The report of Modesto Mendez is mentioned by Mr. A. F. Bandler in his Bibliography of Yucatan and Central America, in 'Proceedings of the American antiquarian society,' 1880, p. 92.

HERMAN BIGALKE.

787 Eighth Avenue, New York.

Barn-owls in Missouri.

In *Science* for Jan. 11 the occurrence of the barn-owl in southern Ohio in unusual numbers the present winter is recorded. The same fact has been noticed here. Four have been caught in the city in as many different buildings, and a number took up their habitation in an unused chimney in one of the principal residences in the city. Another was killed a few miles out. They are so unusual here that no one knew what kind of owl they were when the first was captured.

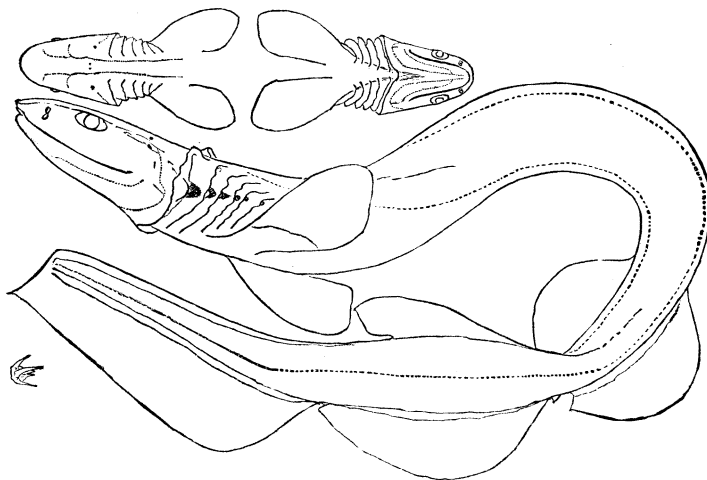
F. A. SAMPSON.

Sedalia natural history society,
Sedalia, Mo.

A PECULIAR SELACHIAN.

THE outlines given here are taken from a shark recently discovered in Japanese waters.

It is a form of more than ordinary interest on account of the respects in which it differs from the majority of its kindred. 'Is it a sea-serpent?' is asked by all who see it. Those who believe in the existence of the ocean monster may certainly derive some encouragement from the discovery. About the throat the appearance is decidedly fish-like. The body is long and slender, five feet in total length, and less than four inches in greatest diameter; it becomes compressed and thin toward the tail. The head is broad, slightly convex on the crown, and has a look about it that reminds one of some of the venomous snakes. The mouth is anterior and very wide. As in other sharks, the teeth are arranged in rows across



CHLAMYDOSELACHUS ANGUINEUS.

the jaws; they are all alike. Each tooth has three slender, curved, inward-directed cusps, and a broad base, which extends back in a pair of points under the next tooth, thereby securing firmness, and preventing reversion. In the twenty-eight rows of the upper jaws, and twenty-seven of the lower, there are three times as many rows of the fangs or cusps. Of the six gill-openings, the anterior are very wide. Unlike other Selachians, in this the frill, or flap, covering the first opening is free across the isthmus, as in fishes, and hangs down about an inch. On the body the slime-canals — shown by the dotted lines in the sketch — form continuous grooves, as if the skin had been cut with a sharp knife; they extend to the extreme end of the tail. The spiracles are so small as to be useless; but, being present, they point toward an ancestor, a bottom-feeder, in

which they were more developed. In the nearly vertical nostril there is a peculiar arrangement. A fold reaching out from each side divides the opening into two, connected within, the upper of which looks forward, and, when moving ahead, catches the water, and turns it into the nasal cavity to pass over the membranes and escape by the lower aperture, which looks backward. Nictitating membranes are absent. The eyes are placed to look side-wise and downward. Above the anal fin, there is a small dorsal. The pectorals are of moderate size. Ventrals, anal, and caudal are large. From these fins, if it were not for lack of firmness toward the edges, one would conclude the animal was capable of great speed. However, taking into consideration the size of the branchial apertures — which allow the water entering the mouth free escape, whatever the rate of motion — and the position of the large fins, it seems as if the creature had the habit of bending the body and striking forward to to seize prey, as do the snakes. The broad fins, so far back on the body, secure a fulcrum from which to strike. At their margins the fins are very thin, and their extremities are produced in a sort of filament. The structure of the jaws and gill arches is such as to admit of swallowing a large object. At the same time the excessive sharpness of the teeth, and the smallness of the intestine, indicate that the prey is comparatively soft. The vertebrae and other cartilages are flexible, as those of the basking sharks *Selache* and *Somniosus*. A certain embryonic appearance in the specimen instigated a search among the fossils for allied species. Most resemblance was found in the teeth of *Cladodus* of the Devonian; but the cusps were erect instead of reclining, and the enamel was grooved or plicate instead of smooth. One is impressed by a study of this specimen with the idea, that, away back in times when *Selachia* and fishes were more alike, he would have a better chance to trace the affinities. The Bulletin of the Essex institute, vol. xvi., contains description and figures under the name *Chlamydoselachus anguineus*. I am inclined to consider this the type of a new order, to which the name *Selachophichthyoidi* might be given, and which stands nearer the true fishes than do the sharks proper. The shark was secured in Japan by Professor Ward, from whom it was purchased by the Museum of comparative zoölogy.

The sketch on the preceding page gives the entire outline, the upper and lower views of the head, and an upper view of one of the teeth.

S. GARMAN.

THE RUSSIAN METEOROLOGICAL SERVICE.

ALTHOUGH the idea that Russia is behind the other powers of Europe in civilization is true when we consider the people as a whole, yet, if we look at what has been done by the Russian government for the encouragement and advancement of science, it must be admitted that Russia plays a very important part in the total amount of scientific work accomplished by the world.

The Russians have the best astronomical observatory in the world: they have also the best meteorological observatory. The magnetical studies have been made in connection with the meteorological; and in the observations, as well as the theoretical discussions, we find the same men engaged, and the results are published side by side. In speaking of the meteorological work, one is forced, then, to at least mention the magnetical, on account of this close connection.

The Physical central observatory at St. Petersburg was founded in 1849 through the endeavors of Kupffer. The aim of this observatory was to institute physical observations and research in general, and to advance Russia in the line of physics; and, as part of the latter task, the conducting and publishing of meteorological and magnetical observations was undertaken.

So it will be seen that this observatory was not intended merely as a central office for a meteorological service; but it was to become a physical laboratory, where all sorts of physical investigations could be undertaken, and in such a manner that nothing more could be desired, that is, as far as apparatus and methods employed are concerned.

The first director, Kupffer, separated as much as possible the two departments of the observatory, as his publications show. His researches into the elasticity of metals, published in 1860, which were cut short by his death, show the nature of the purely physical investigations undertaken by him. He published an enormous mass of meteorological material in the *Annales de l'observatoire physique central*, 1847-64; also in the *Correspondance météorologique*, commenced in 1850.

In seven places hourly observations of the meteorological elements were instituted, and in six places of the magnetical elements. These and many of the observations from other stations, made a certain number of times a day, were published.

In speaking of this material, Professor Wild

said, "It is a complete mass of meteorological and magnetical observations published in detail, and therefore easily accessible to every one, and such as no other land possesses: it is of great value to the science; but it would have been much more valuable, yes; invaluable, if it was as satisfactory as comprehensive."

As at first organized, there were few under-officials in the observatory; and most of them were men who received small salaries, and were not especially qualified for their positions,—or, rather, there were no positions for men qualified,—so that the director was obliged to attend personally to all work requiring much thought. A force, then, of a director and five not specially prepared men was to conduct the work of the central office, from which were to be issued the meteorological observations, and their discussion, of a country five times as large as all the rest of Europe, through which about twenty separate meteorological institutes are distributed.

It is not to be wondered at, then, that Russian observations lay for so many years almost unused by their meteorologists. Any one who has attempted to work with magnetic observations knows that little can be done single-handed, especially if the person must also busy himself with the instruments themselves.

Through inability on the part of the director to cope thus single-handed with the great work undertaken, the meteorological service went gradually into decline. The separate stations could not be properly inspected to see that the instruments were correct, nor could the necessary attention be given to the preparation of the observations for publication. Matters finally came to such a pass, that about 1864 a re-organization of the service was agreed upon, and the establishment of forty new meteorological stations. However, the next year, and before any thing could be done, Kupffer died, and Kaemtz was called to succeed him.

This great meteorologist at once elaborated plans for the improvement and enlargement of the service; but a great undertaking of this kind goes forward slowly, and at his death, two years later, not much had been carried practically into effect.

The service, then, was in a disorganized condition when Wild took charge in 1868. Although it is probable that a great improvement would have taken place had Kaemtz lived, yet we can hardly hope that he would have placed the service in that high position which it now holds in reference to others, and which it assumed so shortly after the choosing of Wild as director.

Professor Wild doubled the corps of assistants, and made the positions so desirable and important that university men were glad to accept them, and good men from other continental countries were easily persuaded to accept places. These men were of such ability that they could undertake and successfully carry out, under the supervision of the director, any single investigations, and thus relieve the chief of that care and constant watchfulness which would have been necessary had he had less skilful assistants. The results of these labors can be seen in the papers published in the *Repertorium für meteorologie*.

But it is mainly of the Russian service as it at present exists, and especially of the meteorological observatory, that I wish to speak.

The whole establishment is composed of several observing-stations of the first order (i.e., where either hourly observations are made, or where self-registering barometers, etc., are employed), and about a hundred and thirty stations of the second and third orders, where observations are made at stated times during the day. In order to obtain an idea of the distribution of these stations, the reader must consult the chart accompanying the *Temperatur-verhältnisse des russischen reiches*, published in 1881 by the observatory.

The meteorological observatory at St. Petersburg consists of two parts,—the Central physical observatory, in the city itself; and the observatory at Pawlowsk, in the country, about thirty kilometres distant. The present building occupied by the former was built about 1860, and continued to be the principal observing-station until 1877, when the other was grounded.

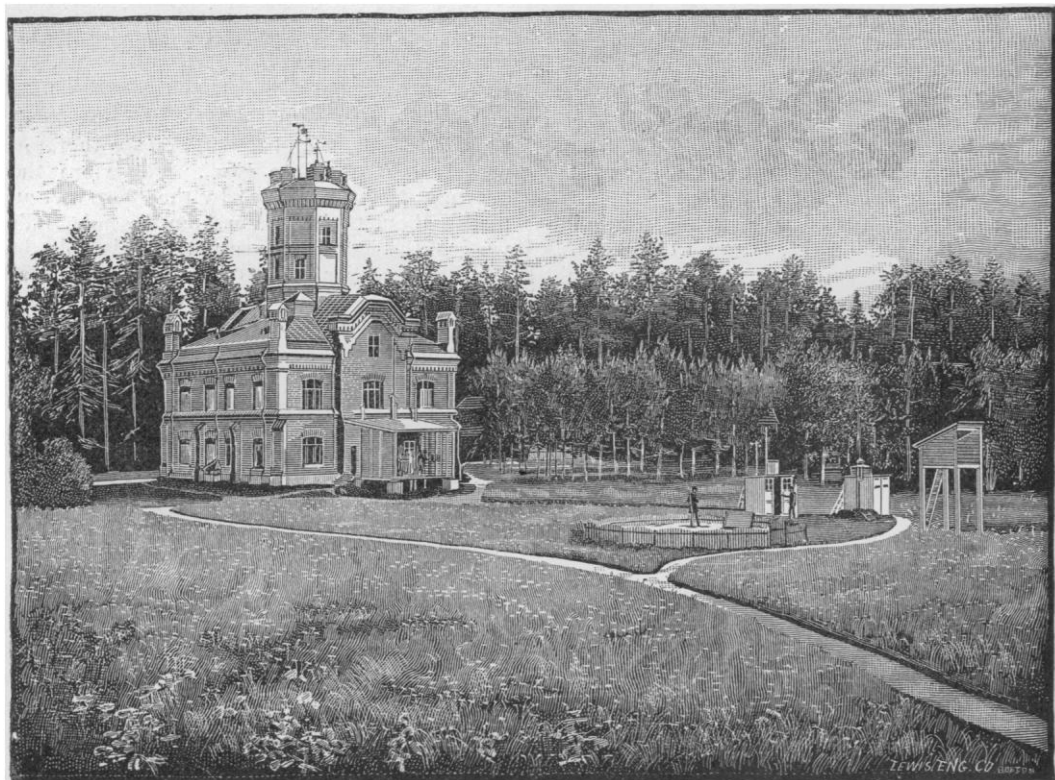
The building in St. Petersburg occupies a not prominent position at a little distance from the north bank of the Neva, in the western end of the city; but it has no longer the quiet surroundings that it probably had at the time of its construction, as the city is extending in that direction.

All of the work of standards, instrument-comparing, preparing matter for the printer, correspondence, supplying stations with necessities, and the general management of the whole service, is carried on here, and for eight or nine months of the year it is the dwelling-place of the director.

For the non-meteorologist, however, the only attractive feature of the institution is the large instrument saloon, where there is much fine apparatus, especially standards. The library is a very good one, and the numerous books in foreign languages show the extent to which the

Russians make use of foreign writings. In fact, very few of the books in the library are in the Russian, even when containing their own work. There is, however, a strong reaction in this

to change it into such a form as he **wanted**. Again, the old observatory was a poor place for magnetic instruments, both on account of the unsteadiness of the instruments, and the close



METEOROLOGICAL STATION AT PAWLOWSK, RUSSIA.

respect ; and before many years we may expect to receive the Russian scientific publications, not in the French and German languages, as at present, but in the Russian. This will be unfortunate for us ; because the language is difficult to learn, and much of their science would be buried to us for a long time at least.

At Pawlowsk there is much of interest. It requires about an hour's time on the railway to go from St. Petersburg to this place. On the way there, the clump of trees surrounding the great Pulkowa astronomical observatory is visible ; and in winter the main building itself can be plainly seen.

There were several reasons for the founding of this new observatory. Professor Wild had ideas that he wished to carry out, and which he considered essential for the best results : he had found the city observatory in a settled condition, and it would have been impossible

proximity to the iron ships that are constantly passing and repassing on the river, only a few hundred feet away. He also had the idea, which is shared by most meteorologists, that the city itself is no place to make meteorological observations ; as the conditions are not the same as in the surrounding country.

This observatory is situated nearly two miles distant from the town of Pawlowsk, which lies thirty kilometres south-east of St. Petersburg. This town, although thinly inhabited in the winter-time, is filled to overflowing in the summer by the people from St. Petersburg, who want to enjoy what little summer country life they can find.

A small portion (several acres) of the park of the uncle of the present czar has been given for the purpose of the observatory, and this piece of ground has been fenced off and the buildings erected upon it. The land lies per-

fectly flat, and is mostly covered with fir trees ; although, of course, part has been cleared, so as not to influence the readings of the instruments. The observatory is certainly the meteorological paradise (at least in summer); and the visitor, whether casual, or there for the purpose of study; cannot but be struck by the taste which has been displayed in its organization and construction. The whole establishment was erected at a cost of about seventy-five thousand dollars.

The accompanying illustration shows the main building from the north side. The large thermometer-shelter is seen against the building; a little to the right, through the trees, is seen the stable; and still more to the right the roof of the director's summer residence is visible. Of the smaller buildings, the one to the right is a thermometer-screen; the other

another rain-gauge, and the black bulb *in vacuo* near these. Inside of the little enclosure is a sand-heap in which are buried the thermometers for measuring the earth's temperature at different depths. The instruments are placed both in a vertical and horizontal position. In order to get at the horizontal thermometers, a hole has been dug, which contains a box filled with earth, the hole being covered by a trap-door. The box can be slid from its position, and the end of the thermometer-cases exposed to view. These are then drawn out (horizontally) by the observer, and read without taking them from the hole. The vertical thermometers are not in this hole, but are drawn vertically out of the sand when read. The glass tubing surrounding the thermometers is so made that no moisture can reach the thermometer-bulbs.



MAGNETIC OBSERVATORY AT PAWLOWSK, RUSSIA.

two for self-registering instruments, one containing a rain and wind measure, and the other a rain-measure and atmometer. There is also

Near this sand-pile is a pond constructed for the purpose of making measures of evaporation on a large scale. The observations of this

kind are not, however, of a very satisfactory nature; and the pond has apparently returned to its legitimate use, viz., furnishing a home for about a million small fishes.

In no place in the world is so much attention paid to magnetic observations and investigations as here at Pawlowsk. We see in this cut the underground magnetic house, and its size can be seen by comparison with the figures in the foreground. The building consists of two chambers, separated and surrounded by air-chambers which are heated; and the heat is thus conveyed through the walls into the observing-rooms. These rooms remain at a wonderfully constant temperature. The building is quite isolated from the remaining portions of the observatory. It was here that the observations simultaneous with those of the recent international polar expeditions were made.

The whole work of this institution is scientific in the highest degree, and there is little of what we may call popular work done; but this is unnecessary, as those who would be influenced by a more evidently practical result have nothing to say in regard to the conduct of the service.

RED SKIES IN CHINA FIVE YEARS AGO.

THE 'red sunsets' which have recently attracted so much attention in so many quarters of the globe, and have called forth considerable discussion in various scientific journals, both in America and Europe, recall very similar phenomena I observed five years ago, under circumstances which seem to me worth recording at this time.

During the early part of the winter of 1878-79, I had occasion to pass several weeks, engaged in geological work, along the base and among the foot-hills of the first mountain range that rises above the plain of northern China, and forms the boundary between the provinces of Chihli and Shansi. Frequently in the month of November my attention had been called to the intense coloring of the sky, and brilliant red afterglows, slowly fading away, and lasting long after the sun had set. On one occasion, Dec. 1, I left the small mountain village of Cheang-Shui, accompanied by my friend Mr. W. N. Pethick of Tientsin, for a long tramp among the hills. We travelled up the long valley, and ascended to the top of the pass commanding an extended view to the westward, over the plateau of Shansi. Although late in the day, we pushed on to the village of Tang-

Cheng-Tsun, a mile and a half to two miles beyond, reaching there about sunset.

On our way back to the pass, I was continually looking backward, astonished at the brilliancy of the sky, the orange-red and peculiar brick-red colors of the horizon, and the length of time the vivid coloring remained after the going-down of the sun. How long this intense afterglow continued I am unable to say; as, on reaching the summit, we retraced our steps down what in the Cordillera would be called the cañon, and the western view was completely lost behind an abrupt wall.

All the phenomena connected with the sunset were quite similar to those recently observed in New York, except, as I now recall the scene, the colors seemed to surpass them in brilliancy.

Through the month of December I was frequently impressed with the deep red glare of the skies, and long twilights, although none of them appeared to equal in intensity the one observed from the top of the plateau. This difference I supposed was due to the view being somewhat shut off by the high ridge to the westward.

As early as November the prevailing winds in northern China blow almost continuously from the north-west, across the broad area of country covered with loess-deposits. In consequence, the atmosphere was never wholly free from fine loess-dust; a haziness being at all times noticeable in the mountains, while frequently the air was gray from the large amount of impalpable dust held in suspension. On those days when the dust was most perceptible the colorings of the skies were never remarkable, and were only fine when the lower atmosphere seemed clear and bright.

These brilliant afterglows continued at intervals throughout December and early part of the new year; the last one being noticed about the middle of January, from a small village seventy-five miles east of the mountains, where I had put up for the night on my way to Tientsin. In the following September I again visited the mountains and plateau of Shansi, but do not recall any thing in connection with the sunsets at all comparable to those observed the preceding winter. But, on the other hand, the atmospheric conditions were also wholly changed; the wind was blowing steadily from the east or ocean side; the air was laden with moisture, which was frequently precipitated in heavy rains; and the atmosphere, so far as the eye could detect, was free from dust. I can but think that the great brilliancy and long duration of the afterglow were intimately connected with loess-dust in some such way

as the recent remarkable displays have been attributed to the volcanic dusts of Krakatoa. The peculiar phenomena in the skies, like those described, were not noticed at Tientsin in the spring. This may be accounted for by atmospheric conditions being changed, and the air at this season of the year being overcharged with too much fine material derived from the dust-storms which form, during March and April, so marked a feature of the climate of northern China. I think it quite probable, however, that red skies, similar to those recently observed in various parts of the world, may at times be seen throughout the winter by foreign residents at Peking and Tientsin.

A few more words about loess-dust. During the winter referred to I was much interested in the question of the loess that was annually being removed from the land and carried out to sea, and not only was impressed with the amount transported by streams, but was led to believe that a not inconsiderable quantity was borne eastward by the prevailing winds, and finally precipitated upon the ocean. Inquiries brought out the fact, that, in the China seas, ships many hundred miles from land frequently report showers of fine material falling upon the decks, which in many cases have been wrongly regarded as deposits of volcanic dust. In conversation with the captain of the steamship *China*, on the passage from Yokohama to Hong Kong in the autumn of 1879, he narrated his experience in a dust-storm, while passing over the same route in the preceding spring. The storm occurred April 25, in latitude 29° , longitude 128° . It lasted twelve hours, with a heavy wind blowing steadily from the north-west. Every thing on board was coated with an excessively fine dust, which, as the captain expressed it, "was so thick that it could be taken up with the fingers like so much snuff." From the rigging, one of the sailors, under orders from the captain, collected with a knife-blade a large amount of the dust, samples of which he forwarded to London for examination. Now, I very well remember that in April the whole plain of northern China was enveloped in several severe dust-storms; two of them, at least, having a duration of three days each, and filling the air at times with dust, so as to completely obscure the sun. There is no question in my mind but that the material which fell upon the steamship came from the loess of China; and I believe that a great deal of the so-called volcanic dusts which are often reported as observed at sea are, at least in Chinese waters, derived from loess-deposits.

ARNOLD HAGUE.

THE EVOLUTION OF THE CEPHALOPODA.—I.

CEPHALOPODS, or cuttlefishes, have structural peculiarities which make them the most favorable subjects now known for the special study of the problems and laws of the evolution of forms in time. In two of the orders the animals were shell-covered; and the shell in these is so built that it preserves, even in the fossils, the embryo, the young shell, and all its stages to the full grown. Then, passing on into old age, it shows in the senile period a series of retrograde transformations, often reversing its adult condition and aspect. This record of the entire life is fuller than any one who has not minutely studied this type can imagine from his experience in other branches of the animal kingdom. It is not only in itself a complete cycle of changes, and these of no slight or doubtful character, but the external records of the shell-structure, apertures, and other parts, are supplemented by the hard portions of two internal structures, which are preserved, and also change in accordance with the age of the shell. We have, therefore, in every well-preserved specimen, the unique advantage of being able to study the complete cycle of its individual life in three distinct sets of organic parts. We can therefore compare the changes which we observe in the individual with the modifications which the group has undergone in its progression or retrogression in geologic times with a certain completeness of the evidences, at present unattainable in any other class of animals. In the Belemnites, the third order, the shell and its parts are much less instructive; and finally, in the fourth, the Sepioidea, it is so much reduced, and so frequently absent, as to lose very largely in this respect.

The class has two sub-classes, Tetrabranchiata and Dibranchiata. These were established by Richard Owen as orders,—a purely technical difference, which does not change in any way the value of the structural distinctions as given by this eminent naturalist. The Tetrabranchiata are shell-covered; and they are represented by the modern *Nautilus*, the only existing genus. The Dibranchiata are descendants of the former, but enclosed the shell, and resorbed it in many forms, so that they appear as naked animals. The cuttlefishes, squid, devil-fishes, etc., are existing types. In studying these types, the author has been led to adopt a new method of characterizing the divisions, and besides the old structural distinctions, which are still available, to apply the

correlations of habit and structure to the elucidation of ordinal differences.

The class Cephalopoda is composed of exclusively aquatic and marine animals, and consequently they breathe with gills. The structures of the two sub-classes coincide with two distinct habitats which they respectively occupy. The Tetrabranchiata, like the Nautilus, were essentially littoral crawlers, though possessing organs suitable for swimming, and doubtless using them more or less for leaping and swimming.

The animal of the Nautilus has a large mantle or fleshy sac enclosing the internal organs, which can be opened around the margin, or closed, at the will of the animal. Admitting the water around the margin, they fill their mantle-cavities with water, and then, closing and compressing the mantle-sac, force it out with violence through a fleshy pipe, which is exclusively used for that purpose, and always situated on the ventral side. The reaction of the stream is sufficiently powerful to drive the body of the animal with varying degrees of swiftness backwards. The fleshy pipe is therefore an ambulatory pipe or hyponome; and we propose, in place of the old and confusing terms, to call it by this name.

The Dibranchiata change the external shell, which they inherit from the Tetrabranchiata, into an internal organ, and taking advantage of the powerful hydraulic apparatus of the Tetrabranchiata, which they also inherit, and increasing its efficiency, become, as is well known, exclusively swimmers.

The ambulatory pipe of the Nautilus causes a corresponding depression or sinus to occur in the aperture of the shell on the outer or ventral side, and its effect is also to be seen in the striae of growth throughout the entire length of the shell on the ventral side; so that we know, from these indications in any fossil, what was the comparative size of the pipe, and whether the animal was more or less powerful as a swimmer. Other indications, such as the openness or contracted form of the various apertures of different genera, exhibit with equal clearness what they could do in the way of crawling. The wide-open apertures indicate powerful arms, capable of carrying and easily balancing the large spire of the shell above: the narrow contracted aperture shows that the arms were small, and that the animal could not so efficiently balance or carry the shell in an upright position, and was therefore, according to the amount and style of the contraction, more or less inefficient as a crawler.

In studying the different types of the Tetrabranchiata, we find that there are two orders as first defined by Professor Louis Agassiz, — the Nautiloidea and the Ammonoidea, — and, further, that these divisions coincide with differences in the outlines of the ambulatory sinuses which indicate distinctions of habit general throughout each order.

The extinct Nautiloidea have large ambulatory sinuses, and were evidently capable, like the modern Nautilus, of rising to the surface, and swimming with a jerky motion; though their open apertures, as a rule, show their normal condition to have been crepitant, or bottom-crawling. The exceptional shells, which depart from the typical form in the sinus and apertures, exhibit their peculiarities in the adults, but not, as a rule, in the young, except in cases where direct inheritance can be proven to have occasioned the exception. The exceptions, then, are, in fact, the most conclusive of our proofs, since they show the power of the habitat to produce permanent changes in the apertures.

The orthoceratitic shells of this order are straight cones, with internal septa dividing them into air-chambers, connected by a tube uniting all the air-chambers, and opening into the body of the animal itself, which occupied a small part only of the whole length of the cone. This is the simplest form: and others are, the bent or arcuate, cyrtoceratitic; the loosely coiled, but with whorls not in contact, gyroceratitic; the closely coiled, with whorls in contact, nautilian; and the still more closely coiled or involute shells, the involute nautilian, in which the outer whorls may simply overlap the inner, or entirely conceal them by their excessive growth, as in Nautilus pompilius.

The Ammonoidea in their earlier forms, the Goniatites, have apertures, with a less strongly marked ambulatory sinus, but still sufficient to show that they must have had considerable powers of rising or leaping in the water, if not of swimming, like the Nautilus. In their later forms, the Ammonitinae, however, the ambulatory sinus is absent; and in its place projecting beaks or rostra are developed, indicating reduction in the size and use of the ambulatory pipe. This and the generally open apertures enable us to see that they were more exclusively bottom-crawlers than the Nautiloidea. The most interesting of the facts in this order lies among the exceptional shells, some of which must have been sedentary, and neither have crawled nor moved about with any ease; but none of these, so far as we know, seems to have exhibited a type of aperture which in-

licated transition to an exclusively swimming habit. These shells appear in our subsequent remarks among the geratologous and pathological types.

The shells of this order have no such variety of form in the paleozoic formations as we have described in the Nautiloidea. They are close coiled, and even involute, in some of the first forms found in the Cambrian.

The Belemnnoidea of the Jura had a solid cylindrical body, called the guard, attached to the cone-like internal shell, and partly enclosing it. Aulacoceras of the trias, as described by Branco, is a transitional form with an imperfect guard, which frequently contains fragments of other shells and foreign matter. This demonstrates an important link in our evidence, that this guard could only have been built by some external flap or enclosing sac, independent of the true mantle. This false mantle must have enclosed both the shell and the guard, and must have been at the same time open, so as to admit the foreign materials which Branco found built into the substance of the guard. One of the straight shells of the Silurian Nautiloidea, *Orthoceratites truncatus*, regularly breaks off the cone of its shell, and then mends the mutilated apex with a plug. This plug, we are able to say, is the precise homologue, in position and in structure, of the guard of the Belemnite. Barrande showed this plug to have been secreted by external organs, as he supposed, — two arms stretching back from the aperture like those of *Argonauta*, and reaching beyond the broken apex. The dorsal fold of *Nautilus* is, however, a secreting-organ stretching back over the shell; and, as the probable homologue of the plug-secreting organ of the *Orthoceratites* and the guard-building organ of the Belemnnoidea, it enables us at once to explain how the Belemnnoidea arose from the *Orthoceratites*, and why Aulacoceras had an imperfect mantle. This fold, which was far larger among the ancient *Orthoceratites*, would have been necessarily open on the ventral side, then more but not completely closed in Aulacoceras, and finally completely closed in the later Belemnnoidea, and able to construct a guard as perfect as that which they carry.

The solid guard of these animals in a compact cylindrical body, such as they were known to possess, could have been only a heavy burden to a swimming animal. The Belemnnoidea, therefore, were not purely natatory; but for these and other reasons, which we cannot here discuss, they were evidently ground-swimmers, probably boring into the mud for shelter, or as

a means of concealing themselves while lying in wait for their prey.

The old view, that the guard could have been in any sense a 'guard' against collisions with rocks, etc., in their wild leaps backwards, is inadmissible for many reasons. The most obvious are its position as an internal organ, its solid structure, and its weight. We think it more reasonable to suppose that it might have increased the liability to injury from collisions. In tracing the Belemnnoidea to the *Orthoceratites* we have simply continued the labors, and carried out more fully the sagacious inferences, of Quenstedt and Von Ihering.

The modern Sepioidea are known to be almost exclusively swimming types; and the more ancient, normal, flattened forms, and their descendants the existing cuttlefishes, have flattened internal shells, in which the striae of growth are remarkable for their forward inflection on the dorsal aspect, due to the immense comparative length of this side of the aperture. *Gonioceras*, a well-known Silurian type of the orthoceratitic Nautiloidea, has the same contours in the striae of growth on the dorsum; and if, as we think, it had a corresponding depression in the aperture on the ventral side, in similar proportion to that of other forms, the aperture must have been transitional to the internal shell of *Paleoteuthis Dunensis* of the Devonian, and to the more modern forms. The septa, also, of *Gonioceras*, have similar curves to the layers of calcareous matter in the interior of the cuttlefish bone, which we look upon as aborted and retrograde homologues of the septa of other forms. *Gonioceras* connects directly with a series of less compressed, straight, orthoceratitic shells; and thus the independent derivation of the Sepioidea from the *Orthoceratites*, among the shell-covered, coniform Tetrabranchiata, is probable. The enclosure and suppression of the shell have already been predicted, with a sagacity which commands our highest admiration, by Lankester, from studies of the embryo of *Loligo*; and these facts carry out his conclusions, substituting, however, the more ancient Sepioidea for the Belemnnoidea, with which Lankester made his comparisons, and the hood for the two mantle-flaps which were imaged by him as the organs which enclosed the shell and formed the shell-sac. Most paleontologists have considered the Sepioidea and Belemnnoidea as more closely allied; but they appear to us as two orders, certainly as distinct as, and perhaps even more widely divergent than, the Nautiloidea and Ammonoidea.

Among these two orders we recognize many

exceptional forms, — such as the *Spirula* among Belemnoida, and among Sepioida the octopods; and we think they all prove our position, that the habitat so closely accords with the structural changes of the type that its purely physical agency must be regarded as the efficient and direct cause of the correlated changes of structure which distinguish the different orders and sub-orders, and often of the exceptional genera and species. We will mention but one of these exceptional cases, in some respects the most pertinent, — the existing Argonauta, or paper nautilus. Here a thin shell secreted by the mantle, by the edge of the mantle, and by the two pairs of long dorsal arms, encloses completely the animal of the female alone, the male being naked. As a sexual organ for the protection of the eggs; as an adolescent and adult structure, originating at a late stage in the life of the individual, and not in the shell-gland of the embryo; and in its microscopical structure, — it is not a true shell, or similar to any true shell among Cephalopoda. Still, in form and position, and as built in part by the mantle, it is a homologue of a true shell, and has in part, also, the functions of a true external shell, and ought therefore to support or refute our hypothesis. It belongs to a swimming animal, and should therefore have the sinus and aperture and striae of growth as in Nautiloidea; and these it certainly has. We can appeal to this example as a most convincing exception to prove the rule that the shell is a true index of the most remarkable adaptive structures, and, among the fossils, can give us exact information of important differences in structure and habits.

The efforts of the Orthoceratite to adapt itself fully to the requirements of a mixed habitat gave the world the Nautiloidea: the efforts of the same type to become completely a littoral crawler developed the Ammonoidea. The successive forms of the Belemnoida arose in the same way; but here the ground-swimming habitat and complete fitness for that was the object, whereas the Sepioida represent the highest aims as well as the highest attainments of the Orthoceratites, in their surface-swimming and rapacious forms.

We cannot seriously imagine these changes to have resulted from intelligent effort; but we can fully join Lamarck,¹ Cope, and Ryder, in imagining them as due to efforts induced by the physical requirements of the habitat, and

think this position to be better supported by facts than any other hypothesis.¹

Confining ourselves to the Tetrabranchiata, which we think the most favorable for our purposes, the next problem presenting itself is whether the two orders, Nautiloidea and Ammonoidea, have had a common origin, or whether they bear internal evidence of having had a distinct origin. The embryo of all Ammonoidea, as shown by the author in his 'Embryology of the fossil cephalopods of the Museum of comparative zoölogy,' and since confirmed by the more extensive researches of Dr. Branco, is the little bag-like shell first discovered by Saemann. This is attached to the apex of the secondary shell. The embryonic bag is called the protoconch by Professor Owen; and the secondary or true shell, the conch.

There is no protoconch in Nautiloidea, as first shown by Saemann, then by Barrande, and subsequently by the author and Branco; but where it ought to have been attached on the apex of the conch, or true secondary shell, there is a scar, first demonstrated by Barrande. The view brought forward by the author, that this scar indicated the former existence of a protoconch in the Nautiloidea, has been opposed by Barrande, Branco, and several authors, on the ground that the cicatrix demonstrated the existence of a distinct embryonic form. Therefore, according to Barrande, the Nautiloidea were not similar to the Ammonoidea in their earliest stages of growth, and must have been equally distinct in origin.

Our present contribution to this discussion is simple and straightforward. We have found the protoconch in several forms of Orthoceratites, of some of which we give figures; and, further, it can probably be found on the apex of the so-called perfect shells, which have no scar or cicatrix. These were discovered by DeKoninck, and supposed by him, in his 'Calcaire carbonifère' (*Ann. du mus. roy. de Belgique*), to be fatal to our conclusion. Having no scar, they could not possibly, according to DeKoninck, have had a protoconch. When the so-called perfect apex is broken off, the observer will probably find that this apex was the shrivelled remains of a protoconch which concealed the cicatrix underneath, as in Fig. 2. There is therefore no essential difference between the embryos of the Ammonoidea and those of the Nautiloidea. There are some of

¹ A noted French writer well known to embryologists, Lacaze-Duthier, has lately asked, "Who, at the present time, supports Lamarck?" The author can answer, that some of our leading scientific men consider Lamarck's hypothesis to contain more fundamental truths than Darwin's or any other.

¹ We can also confidently appeal to Dohrn's hypothesis of change of function in support of this view, in which he shows with many convincing examples that organs have latent functions which can be developed by any change of habits, and then become predominant over the older functions, and by their reactions occasion an entire change in the structure of the organs themselves.

minor importance which we cannot discuss here. These, however, do not interfere with the facts of general agreement; and there is great probability that the shell-covered forms of all kinds which have the protoconch — namely, the ancient and modern Gastropoda, Tentaculites, and the ancient Pteropoda, and all the radical forms of Cephalopoda — had a common origin, probably in some chamberless and septaless form similar to the protoconch. Von Ihering has already designated this prototype as probably Tentaculites. No exact correspondent to the protoconch is yet known to us; but certainly Tentaculites is nearer to the protoconch of both Cephalopoda and Gastropoda than any other known ancient form.

The young of the simplest and earliest of Ammonoidea, the Nautilini, have in varieties of two species, as shown by Barrande, a straight apex, like the adult shell of Orthoceras, the radical of the Nautiloidea. We have already claimed that this fact was sufficient to prove the high probability of a common origin from a straight shell like Orthoceras for both of these orders; and we are now able to reiterate this conclusion, and to meet the objections of the great paleontologist Barrande, and his supporters, more effectually than ever before.

Goniatites compressus, sp. Beyrich (*Sand. verst. Nassau*, pl. 11, fig. 4), is a shell which differs from all other Ammonoidea in an essential and highly important character. The septa have no inner lobe. The v-shaped annular lobe which occurs in all the Ammonoidea except the Nautilini is also absent in this species. What is more to the point, this shell has the sutures of a true nautiloid, since it has the dorsal saddle, in place of the dorsal lobe, of the sutures of its nearest allies, the Nautilini, and all of the remaining Ammonoidea. *Goniatites ambigena* Barr., of the Silurian, is a close ally of this Devonian species, and the two are the only Ammonoidea which are not truly nautilian in form. The whorls are in contact; but there is no impressed zone, and no sutural lobes on the dorsum, as in true nautilian shells. On

the contrary, they are purely gyroceran forms, with rounded dorsum and sutural saddles in place of lobes. All of the Nautilini and *G. compressus* also have the septa concave, as in the Nautiloidea, in place of the convex character of the septa in later Ammonoidea. As doubts may disturb the mind as to whether *G.*

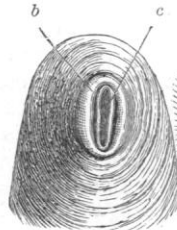


FIG. 1.

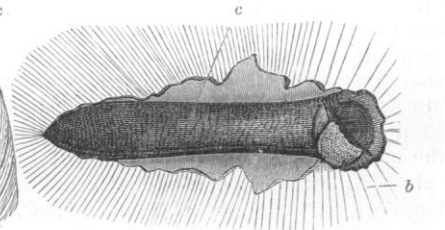


FIG. 2.

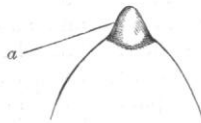


FIG. 3.

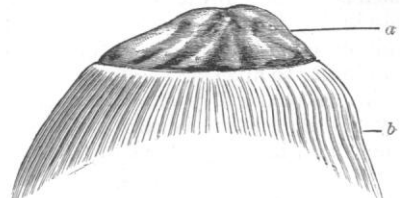


FIG. 4.

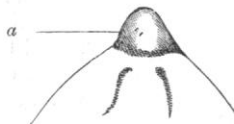


FIG. 5.



FIG. 6.

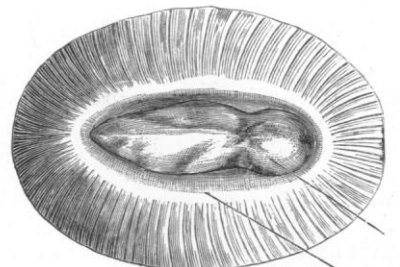


FIG. 7.

FIG. 1. — Aspect of the apex of the conch in *Orth. unguis* Phill., after the protoconch has been shed in the usual manner. *b*, conch or shell of the apex; *c*, cicatrix.

FIG. 2. — Aspect of the apex, after the protoconch has been accidentally broken off, fracturing the outer shell, and exposing the cicatrix. *b c*, as before.

FIGS. 3-5. — Apex and protoconch of *Orth. elegans* Munst. from the front, side, and above. *a*, protoconch; *b*, shell of apex.

FIGS. 6, 7. — Another individual, said to be of the same species, less magnified. *a b*, as before. The author has also, in other species, traced the striae of the outer shell on the protoconch itself, showing the continuity of the shell over this part (*a*), and completing the evidence that it must have been the shell which enclosed the embryo, and could not have been a mere plug, as asserted by Barrande (*Syst. sil.*, pl. 488).

compressus is an ammonoid at all, we recommend a comparison of this shell with the young of *Goniatites fecundus* of Barrande, which is a miniature copy made by heredity.

Bactrites is a perfectly straight form, similar to these *Goniatites* in very important characteristics, especially the siphon and septa.

This same genus includes straight cones like

Orthoceras pleurotomum Barr. (*Syst. sil.*, pl. 296), which are undeniably transitions to true *Orthoceras* in their striae of growth and position of siphon. There is therefore convincing evidence in the structures of these Cambrian shells that the Ammonoidea, with their distinct embryos, arose from the orthoceran stock, and passed through a series of forms, in times, perhaps, preceding the Cambrian, which were parallel to those characteristic of genetic series among Nautiloidea; viz., straight, arcuate, gyroceran, and nautilian.

The researches of Emmons and Marcou in this country, and the discovery of ten thousand feet or more of stratified rocks under the Cambrian by the U. S. geological survey, and the inferences of Bigsby from the extended study of Silurian and Devonian fossils, are beginning to place the probable existence of a pre-paleozoic period beyond question, in spite of the really grand opposition and world-wide researches of Barrande. The study of the tetrabranchs teaches us, that, when we first meet with reliable records of their existence, they are already a highly organized and very varied type with many genera, and that the name 'paleozoic,' as applied to these first records, is a misnomer. There was a protozoic period; and the tetrabranchs, like their successors, certainly must have had ancestors which preceded and generated them in this period, but of which we are at present necessarily ignorant. Whatever the future may have in store for us we cannot now predict; but at present the search for the actual ancestral form, though necessary, is nevertheless not hopeful. We can, however, rely upon the facts of embryology, and predict without fear of failure, that, when our knowledge makes this prototypical form known, it will have a decided resemblance in structure and in aspect to the earlier stages of the shell as observed in the fossil cephalopods.

(To be continued.)

SCALES OF COLEOPTERA.

SOME of the more interesting forms of scales of Coleoptera described in the paper by Dr. George Dimmock, noticed in *Science*, i. 455, are shown in the annexed figures. The scales of the carpet-beetle, *Anthrenus scrophulariae*, and of the museum pest, *A. varius* (fig. 1), resemble in general form those of many Lepidoptera, as do also the scales of *Valgus squamiger* (fig. 3). The scales of *V. squamiger* are, however, hairy, in fact, almost shaggy. The scales of *Hoplia coerulea* (fig. 2) vary from round to lanceolate, those of the dorsal surface being transparent yellow when viewed by transmitted light, and blue by reflected light. Those of

the ventral surface are purplish, purplish red, red, bluish, and colorless by transmitted light, while by reflected light they are silvery white, with at times a tendency to metallic green. The scales of the dorsum are smooth, filled with fine reticulations (fig. 2, d), but those of the ventral portions and of the tip of the

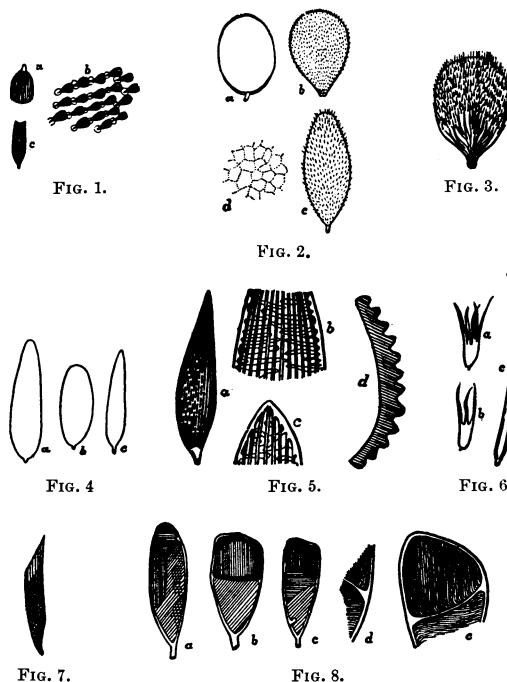


FIG. 1.—Scales of *Anthrenus*: *a*, of *A. scrophulariae*; *b*, arrangement of same on portion of an elytron; *c*, scales of *A. varius*. Enlargement: *a* and *c*, 100 diam.; *b*, 50 diam.

FIG. 2.—Scales of *Hoplia coerulea*; *a*, from elytron; *b*, from under side of thorax; *c*, from femur; *d*, fine structure to be seen in *a*, with high powers. Enlargement: *a*, *b*, and *c*, 100 diam.; *d*, 500 diam.

FIG. 3.—Scale of *Valgus squamiger*. Enlarged 100 diam.

FIG. 4.—Different forms of scales from *Chalcolepidius rubripennis*. Enlarged 100 diam.

FIG. 5.—Scales of *Alaus oculatus*: *a*, brown scale; *b* and *c*, portions of white scales to show cross-bands; *d*, transverse section of a brown scale. Enlargement: *a*, 100 diam.; *b* and *c*, 300 diam.; *d*, 500 diam.

FIG. 6.—Scales and hair of *Ptinus? rutilus*: *a* and *b*, scales from elytron; *c*, hair from elytron. Enlarged 100 diam.

FIG. 7.—Scale of *Clytus robiniae*. Enlarged 100 diam.

FIG. 8.—Scales of *Entimus imperialis*: on *a*, *b*, and *c*, vertical lines indicate blue, horizontal lines indicate carmine red, and oblique lines yellow; where two kinds of lines cross, one color is tinged with the other; on *d* and *e* the fine lines represent the finer striation of the inner layer of the scales. Enlargement: *a*, *b*, and *c*, 100 diam.; *d* and *e*, 300 diam.

abdomen are covered with fine hairs representing the branches of the ordinary hairs of scarabaeidous beetles. The scales of *Chalcolepidius rubripennis*, an elaterid, are transparent brown when seen by transmitted light, but by reflected light appear bronzed blue, green, or red. Their form is seen in fig. 4. The black and white scales of *Alaus oculatus* (fig. 5), which give rise to the entire figuration of that curiously marked elaterid, although not of especially pe-

cular form, are very interesting; because, in the white ones, the striations of the outer lamina, which form the corrugations seen in sections of the scales (fig. 5, *d*), are longitudinal, while the lower lamina, or lamina toward the insect, although smooth, shows transverse bands (fig. 5, *b, c*). In the fact of their corrugated surfaces being turned away from the insect, the scales of *Alaus* and of some other Coleoptera agree with the scales of Lepidoptera and Diptera. The 2-7 pointed scales of *Ptinus* (fig. 6), which are nestled amongst its hairs, resemble in a general way the plumules of some Lepidoptera. Most of the coloration of the well-known locust-borer, *Clytus robiniae*, is due to scales (fig. 7), which are of a form not rare in the longicorn Coleoptera.

The Rhynchophora or Curculionidae are the beetles on which scales most generally occur, and where they present their most brilliant coloration. The diamond beetle of South America, *Entimus imperialis*, often sold by jewellers on account of its brilliancy, has scales (fig. 8) and hairs which present to transmitted light various colors—usually red, blue, and yellow; often all three colors with gradations between them—on a single scale. By reflected light, or upon a black surface like that of the beetle itself, the prevailing colors are green and purple. The colors which are indicated by the direction of the lines on the figure (fig. 8 *a, c*) are those seen by transmitted light. When highly magnified, these scales, besides other structural characters, show a very fine striation (fig. 8, *d, e*), sometimes in one direction on one part of the scale, and in another direction on another part. This fine striation is probably the cause of the brilliant coloration of these scales.

All the brilliant coloration of scales of Coleoptera appears to be due to interference of light, either by fine striation, or by superposed delicate lamellae; as can be proved by wetting the scales with chloroform, when the color disappears, only to reappear as soon as the chloroform is evaporated. Most of the scales of Coleoptera contain air; and this air, together with the background formed by the coloration of the insect itself, gives rise to the various changeable hues seen in most of the Coleoptera which have scales.

MICROBES.¹

NONE of the organic substances which form an essential part of our sustenance, and are useful in a thousand ways, can be kept for more than a few days: fermenting and spoiling, they are the despair of the economists. In this decomposition the substance becomes filled with an immense number of very minute organisms. How can a liquid, like milk or soup, free from all foreign germs, become invaded in a few hours by these innumerable legions of microbes? The first hypothesis suggested is, that all these organisms are the result of the decomposition, and that they are produced spontaneously at the expense of the altered substance. This is the theory

of spontaneous generation, so vigorously maintained by Pouchet; and it is certainly one of the greatest of Mr. Pasteur's good offices, that he has refuted one by one the arguments of the supporters of this attractive theory, pursued them to their last defence with his invincible logic and his unexceptionable experiments.

The fermentation is produced by the microbes; and these, by a wonderfully rapid propagation, are derived from germs carried by the air, or adhering to the vessels which hold the fermentable liquids. The diligent researches of Mr. Miquel show that the comparatively pure air of the suburbs of Paris holds from a hundred and fifty to a thousand living germs per cubic metre. In a hospital at the centre of the capital, each cubic metre of air contains from five thousand to thirty thousand, according to the season. Although these figures appear prodigious, they are nevertheless very small, compared to the number of spores which cling to all the solid objects surrounding us. A simple cleansing is powerless to remove them: only fire or strong antiseptic solutions can destroy them. A fermentable liquid can be preserved indefinitely if it is protected from all microbes; but it is easily seen, after what we have just said, how difficult it must be to obtain this perfectly insulated state. All these lower vegetable types are found in two forms, — 1°, the vegetative or active form; and, 2°, the passive form, that is, the spores, which play here a part analogous to that of seeds in plants.

In the active state most microbes show little endurance; many species cannot stand a drying of any duration; and in moisture a temperature of 70° to 86° C., continued for two or three hours, destroys them almost without exception. Spores are more hardy: boiling water does not kill them; but, for this purpose, water must be heated to 120°, 130°, and even 150°. When dry, the spores do not succumb to a temperature below 180° to 200°; and, according to Mr. Fricz, cold of 110° has no effect upon them. To disinfect clothing without burning; would, then, be an impossibility, if, fortunately, Mr. Koch had not discovered that the germs cannot resist the action of a continued current of steam at a temperature of 100°.

It is peculiarly difficult to protect a liquid from all germs, or to destroy all those which have penetrated it; however, it is possible, and the liquid is then said to be *barren*. Certain soups are prepared in this way that they may be sown with very small particles of substances containing the microbes to be studied; and thus the desired species obtained, to the exclusion of every other. Laboratories devoted to these studies annually distribute hundreds and thousands of litres of these soups.

The organisms which here claim our attention belong to three families, all allied to fungi, — moulds, yeasts, and microbes proper. Each kind of fermentation is produced by a certain species of these small organisms, and takes place only if the species in question is present in the liquid, from the beginning of the fermentation, in sufficient numbers not to be

¹ By Dr. H. FOI of Geneva. Translated from the *Journal de Genève*.

choked by other species. Thus the mycoderm of wine is found in abundance in the flower of the bitter grape, and is naturally scattered in the must which flows from the press. In Japan the vine grows with wonderful rapidity, and bears magnificent grapes; but the mycoderm is lacking, and the fermentation produced by the other microbes yields only an undrinkable liquid. The bakers and brewers know very well how to introduce into their dough and must the species needed. Without microbes, milk would not curdle, cheese and vinegar would be unknown; the vegetable *débris* would not decompose, and there would be no loam. Some one has calculated that a gram of soil contains a million of these little creatures. We are so accustomed to associate the word 'microbes' with the most dreaded diseases, that we lose sight of the important part they play in nature. We can confidently say that their suppression would completely overthrow the present order of things.

The power of causing fermentations is certainly one of the most curious phenomena which these lower vegetable types present. This power belongs only to certain species. Mr. Pasteur was the first to discover that certain microbes live in the air, and breathe like animals: these do not produce fermentation. Others live only when protected from the air, and cause fermentation in the matter which contains them. To these two classes there has recently been added a third, amphibious microbes, simply vegetating while in the air, and producing fermentations only when the air is withdrawn. Fermentation thus seems to be a kind of respiration. The yeasts decompose liquids in order to obtain products rich in oxygen, which take the place with them of respirable air. These facts are highly important in explaining the mechanism of diseases.

In short, from a practical point of view, we may divide microbes into three classes,—those which are useful, those which seem to have no effect, and those which are positively harmful. We have already mentioned the first class; the second are very numerous; for, to say nothing of the many species which inhabit all the recesses of nature, and concern us only very indirectly, we undoubtedly support quantities of them in the cavities of the surface of our bodies and of our digestive canal. Nothing equals the astonishment and confusion of very solicitous persons, when, by a turn of the hand, the micrograph shows them all the various forms which live at their expense. They are all kinds, from the harmless *Spirillum* in the saliva to the *Leptothrix*, which is the most active agent in the decay of teeth. But all this is on the surface: the interior of our bodies is completely free from them; and it may be said that in our organization every means is taken to defend the entrance to the organs from ordinary microbes, and to remove them if they succeed in forcing entry. There is, however, a certain number of species which have the sad privilege of being able to penetrate and support themselves in the body of a subject predisposed to receive them. The microbe of septaemia enters only through an open wound, while those of tuberculosis and leprosy attack directly the lungs or

mucous membranes of the persons afflicted. The surfaces of the lungs and of the alimentary canal seem to be the customary points of attack for the organisms which cause various infectious diseases.

Our organization is like that of a civilized nation, whose citizens are represented by our cells. The skin becomes broken (the wall of China discloses a breach), and immediately there are hordes of savage microbes which enter, at strife with the national soldiers (our cellular tissues). The microbes multiply, and scatter around a poisonous liquid; the cells combine, and try to starve their dreaded enemies and to repair the breach. The battle-field is small; but the victory is warmly contested, and the sight has its exciting aspect. The result of the struggle depends on the number of combatants and on the energy of the competing forces. The antiseptic treatment of wounds, as at present skilfully used by Professors Julliard and Reverdin, and Dr. A. Reverdin, aims to reduce as much as possible the number of microbes which enter, and to retard their development; for no one familiar with the subject would think it possible to entirely exclude them. How interesting it would be to trace the events of the contest between the organism and its invaders in the case of an epidemic disease! Science, we hope, will soon be in condition to give us this history.

The diseases which have been traced with certainty to parasites are as yet few in number: they may be counted on the fingers. To discover the nature of a disease, there must be a uniformity of experiments and evidence, of which the public, and even the majority of specialists, take no account. Nothing is easier than to examine with a microscope small parts of the various organs of a dead body, and attribute the fatal disease to the microbes found under these circumstances. These would-be discoveries, soon disproved, have only the effect of causing the public to mistrust useful investigations, and cast undeserved discredit on serious work performed in the most methodical manner. To know a parasitic disease, it is not enough to have seen the pathogenic microbe: it must have been removed from the other microbes, and cultivated through a long series of generations in sterilized soups; animals must be inoculated at various times with these pure types, and each time all the symptoms of the disease whose cause is sought must be observed. In this way Mr. Koch has revealed the microbes of charbon and tuberculosis; and these discoveries have been granted to science, after being examined by a number of investigators, among them Professor d'Espine. Long and very careful cultivation was necessary to show, after Dr. Hattenhoff's interesting paper on this subject, that the juice of the *jequirity* owes its extremely virulent properties only to the microbes which it contains. We know quite satisfactorily the organisms which produce leprosy, erysipelas, and symptomatic charbon; but for diphtheria, typhus, intermittent fevers, and many other diseases, the agents are still undiscovered.

Intermittent fevers afford a good example of how easily errors arise and spread. They were at first, and

without sufficient evidence, said to be caused by the palms, — comparatively high vegetable types, perfectly innocent of the crime of which they were accused. Late investigations point to a bacterium of elongated form as the cause, but the proofs are still insufficient. To learn to recognize the enemy is certainly the most necessary thing to be done, but it is only half the task: we must then learn to resist it. The more or less effective means of combat which have been employed up to the present time have aimed, 1°, to prevent the dissemination of dangerous microbes; 2°, to make the organism unsuitable for the propagation of the intruders; 3°, to retard, as far as possible, the growth of those which have entered, in order to give the organs opportunity to throw them off. The first of these measures engrosses the attention of the hygienists: hospitals, quarantines, and disinfectants are among the means employed. I will not enter upon a subject which touches so many disputed questions, but will confine myself to noticing certain facts and to rectifying certain very wide-spread errors. Regarding infection, the nose is a poor guide; for the experiments of Mr. Miquel show very distinctly that substances in a state of putrefaction, so long as they are moist, do not emit living germs. The water of the Paris sewers holds eighty million microbes per litre; and yet the air of the sewers contains only eight hundred or nine hundred germs per cubic metre, about one-tenth the number found in a hospital. By inoculating a rabbit, it was shown that these germs are perfectly harmless. The moist earth does not give out living organisms to the atmosphere. On the contrary, the dust of our rooms, which we do not at all mistrust, shows about two millions of these living germs per gram. The bacteria of intermittent fevers, which vegetate in the soil of the Roman Campagna, begin to spread in the air and to become dangerous only when the soil, dried by a scorching sun, is raised by the wind in the form of dust. It would be easy to multiply examples, and to prove, that, in point of hygiene, we must be guided by sense rather than by smell. We have as yet but begun this kind of study; for how does this total number of germs which the air or water holds interest us? We would prefer to know the number of dangerous germs. The proportions would doubtless be very different from those which concise analysis affords.

Until we are better informed, we shall do well to push cleanliness to an extreme, and especially to put little trust in disinfection. The number of substances which are less injurious to man than to micro-parasites is very small. The best disinfectant is perfectly useless if too weak a dose be used. For each of these substances there is one proportion which will destroy the germs, and another which will arrest their vegetation but not destroy them. This last dose is the one with which we are generally obliged to content ourselves. The experiments of Mr. Koch and Mr. Miquel show that the narcotic effect begins to be effective on microbes only when the substance in which they are vegetating contains, among a thousand parts, 95 parts of alcohol, or 70 of

borax, or 10 of salicylate of soda, or 3.2 of phenic acid, or 5 of quinine, or 0.6 of bromine, or 0.07 of bichloride of mercury, or 0.05 of oxygenated water. Certain of the substances indicated are useful in these doses; while others, as bromine, are impracticable. But especially let us not forget that the result is not a radical disinfection: it is merely a momentary weakening. Is it still needful to insist on the uselessness of too mild doses? We are constantly seeing phenic acid used at less than one in a thousand parts with the sole effect of creating a mistaken sense of security. Let me mention another almost unknown antiseptic: essence of terebinthine, according to Mr. Koch, arrests the vegetation of microbes in a dose of $\frac{1}{750000}$, a quantity easily endured by man.

All these hygienic precautions are bristling with difficulties. How convenient it would be to let the microbes live and to protect our bodies from their influence! Unfortunately we know but one way to effect this: it is based on a remark, made long ago, that certain diseases can be retaken only after many years, and that this freedom may be obtained by contracting the disease in a very mild form. This is the principle of vaccination, and also of inoculation, employed by Mr. Pasteur on certain animals. The matter inoculated contains the microbe of the disease from which we wish to protect the subject, but modified by a special cultivation: it is a virus weakened according to the methods of Mr. Toussaint and Mr. Pasteur. We touch here upon a question, at present much contested, in regard to the regularity of specific forms of these very low vegetable types. Mr. Zopf and the school of Munich believe that the most harmless species can, under certain circumstances, be changed into dangerous ones, and *vice versa*. The school of Berlin thinks that artificial modifications are only transient and momentary, and that the species may be considered invariable. However this may be, it is certain, that, if the inoculations of Mr. Pasteur have no great practical importance in their present form, they at least have a considerable theoretical value. We may hope that the time will come when it will be possible to vaccinate for all diseases which can seldom be taken a second time. Who knows if it will not end by discovering the nature of the influence which the parasitic invasion exerts on the tissues of our bodies, and in obtaining the same result in a more direct way without inoculation? When we consider the progress of science in the last half of the present century, we venture no longer to answer, 'Impossible.'

THE WATER-PORES OF THE LAMELLI-BRANCH FOOT.

IN 1817 Cuvier showed that in *Aplysia* there was a closed vascular system, and claimed the same for all Mollusca. His view was followed till 1845, when Valenciennes and others described in many lamelli-branchs pores which passed through the foot to introduce water into the lacunar tissue, where the blood circulates. This view found general acceptance, and

was taught by Siebold, Huxley, Gegenbaur, Semper, etc. Recently discussion of the subject has been reopened by the appearance of numerous papers. Mr. Justus Carrière in several papers maintains that no *pori aquiferi* exist in the lamellibranch foot. Hermann Griesbach, last spring, in a careful paper (*Zeitschr. wiss. zool.*, 38), reviewed the whole subject, studying by sections and injections, and concluded that the molluscan vascular system was not closed, that the blood wandered in the lacunar tissues of the body-cavity, that large lacunar spaces communicated directly with the exterior through aquiferous pores in the foot, and that these pores were for the reception of water to be carried out through the Bojanus organ. He figures sections of Anodonta where the surface-epithelium of the foot bends up into the opening of the pores (there are three in Anodonta), and fades out as the pore opens into the lacunar body-cavity. During last October two quite independent papers appeared simultaneously upon the other side. Dr. Cattie, in *Zool. anzeiger*, vi., No. 151, p. 562, claims to have cut a complete series of about twenty-five hundred consecutive transverse sections through the foot of Anodonta. In no one of these was there any break in the epithelium: He has studied twenty-three species, and in no one finds the least trace of aquiferous pore. Dr. Th. Barrois, in a private imprint from Lille, dated Oct. 30, 1883, arrives at the same results. He discusses the work of Carrière and himself, and finds that they have studied most of the forms where the presence of aquiferous pores has been claimed, and in every case find pores absent, or in such position that it seems they are either connected with the functional byssogenous organ, or, where such is absent, in the adduct, with the remnant of the same. Barrois sums up his views thus: no pores exist for the introduction of water into the circulation; the only pores of the foot are those connected with the byssus organ, which never communicates with the interior of the foot. The blood may have water introduced into it, but this must be effected by osmosis, or in some manner not now to be discussed.

H. L. OSBORN.

THE BORDERLAND OF SCIENCE AND FAITH.

Walks in the regions of science and faith: a series of essays. By HARVEY GOODWIN, D.D., Lord Bishop of Carlisle. London, Murray, 1883. 310 p. 8°.

Natural law in the spiritual world. By HENRY DRUMMOND, F.R.S.E., F.G.S. New York, James Pott. (Apparently sheets of the English edition.) 414 p. 12°.

THE 'science' of these regions is of course physical science; the 'faith' is the theistic and more specifically the Christian faith. These 'walks' are taken along the borders of the two. Normally, the course of this journal of science lies quite away from this borderland, which, indeed, has not always been an agreeable road for a scientific man to travel. Of late, how-

ever, a better understanding has made it pleasanter than it was for the peaceably disposed naturalist. And the Bishop of Carlisle, a trained mathematician as well as a divine, whose thoughtful essays are essentially irenic, is an instructive companion in an excursion "through that land which belongs exclusively neither to science nor to faith, but appertains more or less to both." A book "which opens with an essay on the connection between mechanics and geometry, which closes with a funeral sermon preached in Westminster Abbey," and the larger part of which had already appeared in widely read periodicals, — some of the articles being in fact, though not in name, of the nature of critical reviews, — hardly need be, and could not well be, reviewed in our journal; yet we are free to give a brief account of it, enough to indicate its lines of thought.

The first essay, on the connection between mechanics and geometry, is a modified reprint of a paper which was published almost forty years ago. The point made is, that these two sciences are essentially identical, being developments in different subject-matters of the selfsame ideas. The moral is, "that all demonstrations tend to merge in intuition, and that human knowledge, as it becomes more clear and more thorough, converges toward that absolute intuition which is the attribute of the Divine Mind." This idea is further worked out in the second essay (entitled 'The unity of nature, a speculation,' which appeared in the *Nineteenth century* in 1879), in which it is argued, that as the schoolboy begins by painfully proving the simpler theorems in geometry, and ends by perceiving that they are really self-evident, and that as all the propositions of Euclid appeared intuitively true to Sir Isaac Newton, "it is quite conceivable, by merely extending in imagination the powers of which we have actual experience, that all geometrical truth in any department might exhibit itself without intermediate steps of demonstration to a mind of sufficient acuteness, when the appropriate definitions had been given. . . . To a mind like that of Newton, I should imagine that the principles of mechanics would present themselves almost in the same self-evident light as those of geometry." And "that possibly, as the truths of geometry help us to realize those of mechanics, we may use the truths of mechanics to help us to realize some of the truths of the more subtle sciences, say, even that of biology." And the speculation, fortified and illustrated by mathematical analogies, goes on

to the conception, that "there may be a principle or law from which the existing order of physical life, with all its apparent anomalies [and its manifold diversities], flows as a necessary result," the knowledge of which, "if attainable, would exhibit to us the order of living nature as one consistent system, free from exceptions and anomalies."

All this, and indeed all the volume, proceeds on lines quite accordant with those of the purely scientific evolutionist. Moreover, in thus regarding intuition as a kind of acquisition or development, the theologian joins hands with the agnostic evolutionist, although they are moving in opposite directions. But the latter doubts, to use the words of one of them, "whether the law-governed mind of man is not itself the highest form of mind." The former, accepting "the admission which must be made by all parties of the co-existence of fundamental unity with almost unlimited diversity," and of inexplicable anomalies, endeavors to show, through mathematical analogies, that the existence of man may involve "the possibility of snakes, as truly and as really as the existence of elliptic motion involves that of parabolical," and "that a mind higher than human might see in the definition of man the possible existence of useless organs, both in man and in other creatures." At the close of the essay, descending from pure speculation of what may be, to more scientific considerations, his idea may be gathered from the following condensed abstract:—

"Let it be granted that all living beings have been developed according to some law, not necessarily known, or even capable of description in words, but still a real law of development; does this give us all the elements necessary for the solution of the life problem? If we say *yes*, do we not run into the mistake of a beginner who fancies that he can solve a problem of motion round a centre when he has been told what is the law of force? Is it not necessary to know the conditions of projection, the initial circumstances of motion or development? And may not this portion of the data be quite as important as the knowledge of the law of force? It seems to me that they who are most anxious to establish the principle of evolution should be the most ready to perceive the necessity of taking into account the consideration of initial circumstances. . . . A quantity of protoplasm with an assumed power of development will not account for existing forms of life, without the additional hypothesis of some causative power to determine the initial circumstances. Given an original germ, and given some power which shall direct the particular original cause of the development of that germ, and the whole subsequent development is conceivable: but the germ and the law of development left to themselves may be as insufficient for the particle and the law of attraction. . . . We have seen that the parabola, the ellipse, and the hyperbola are all possible curves for a particle moving round a centre of

force. Only one of these curves—namely the ellipse, and only the ellipse under the condition of small eccentricity or approximate circularity—can suffice for the orbit of a planet which shall be the home of the highest form of life, namely, that of man. . . . The original conditions of motion, the initial circumstances as a mathematician would call them, must have been delicately adjusted in order to select, out of all possible forms of orbit, that one circular or nearly circular form which is compatible with the existence upon the earth's surface of beings like ourselves. May we not infer from this a similar necessity of original delicate adjustment in the process of the evolution of a highly organized creature from a protoplasmic germ?"

The third essay, entitled 'God and nature,' is mainly the development and application of a point made in a university sermon, which the author thought had been overlooked (but perhaps it really passed unnoticed because it is so obviously true), namely, that "all physical science, properly so called, is compelled by its very nature to take no account of the being of God: as soon as it does this, it trenches upon theology, and ceases to be physical science." And so, coining a discriminating word to express this, he would say that science was *atheous*, and therefore could not be *atheistic*. Intrenched in this position, he sharply criticises, as unscientific, Haeckel's denial of the existence of purpose in nature, and comes down upon Professor Seeley for his rash statement (in 'Natural religion') that 'science opposes to God, nature.'

In the fourth essay, 'The philosophy of crayfishes,' the text is supplied by Mr. Huxley's well-known lecture upon these little crustaceans, which lecture, the bishop insists, "leads the mind of the reader, and, as it would seem, intentionally, beyond the region of natural history into the domain of philosophy, and even of divinity." In that domain the bishop is a match for the naturalist: at least, he is able to verify an old prediction of Huxley's, that the evolutionist need not expect ever to drive the teleologist out of the field. Indeed, it cannot be easy to dislodge a teleologist who is so far-sighted as to "have great doubt whether we can properly speak of final ends at all, unless we embrace in our conception the whole cosmos." To Huxley's favorite line of remark that there is no great good in "demonstrating the proposition that a thing is fitted to do that which it does," and that it is "merely putting the cart before the horse to speak of the mind of a crayfish as a factor in the work done by the organism, when it is merely a dim symbol of a part of such work in the doing," the bishop replies, that the importance of demonstrating a proposition depends upon the point of view

from which the proposition is regarded; that the assumption made, "that the preservation of the individual and the continuance of the species are the final causes of the organization of an animal," is quite on a par with the old-fashioned teleology which is nowadays justly reprobated; that, at any rate, the pleasure which the crayfish apparently takes in watching for and capturing his prey is something quite distinct from 'work done by an organism;' and that, "if pleasure of some kind be denied to the crayfish, contrary to all appearances, I do not know at what point in the scale of animal life pleasure is to be admitted as a factor. If to speak of mind as a factor in work done be an absurdity in the case of a crayfish, is it not an absurdity in the case of a dog, or even in the case of a man?" And he proceeds to vindicate the delight of existence as one of the ends for which animals exist.

This idea, and the vindication of the mind of brutes, have a prominent place in the next following essay, on 'Man's place in nature.'

'Law, physical and moral,' is the topic in the sixth essay, in which a passage from Hooker's 'Ecclesiastical polity' is set over against one from the Duke of Argyll's 'Reign of law.' We need not continue our analysis, which is already longer than was intended: indeed, there is less occasion to continue; for the remaining articles, being popular addresses reproduced, are less thorough, however sensible. Even the last essay, on 'Evolution and evolution,' and the appreciative funeral sermon for Charles Darwin preached in Westminster Abbey on the Sunday following his burial there, need not detain us.

The noteworthy thing, to which this volume adds its testimony, is this: that thoughtful churchmen are following the example of thoughtful men of science. They are accepting the scientific principle of evolution as a working-hypothesis, — trying it, as naturalists and physicists have done, in their several lines of research and thought, and with somewhat similar results. The new science is accepted with complacency, if not with welcome, by the discerning. The questionable philosophy, in which it has too often been dressed, is examined and exposed.

THE second book named above appears to have excited considerable attention in England. Like the volume we have just noticed, it is an excursion into the borderland of science and faith, but with a difference. The divine is the more scientific, the layman and naturalist (for

such we take him to be), the more homiletical of the two. The one picks his way along the ground with firm but cautious and carefully chosen steps: the other soars into the air. The one discriminates between science and faith, and in his book guards rather than enters upon the field of morals: the other seeks to identify the two, and in a novel way. He has discovered that natural laws, meaning the principles of physics and biology, extend to the spiritual world, and help us to understand it. He does not mean that there are analogies between the two, which may be profitable for instruction, but identities; that 'in the spiritual world,' to use his own figure, 'the same wheels revolve, but without the iron.' And the laws to which he refers are the principle of continuity, of conformity to type, of environment as causing variation, the adage *omne vivum ex vivo*, possibly even gravitation, if there be any thing for it to act upon; and, if there is nothing for these laws to act upon, "it is not the law that fails, but opportunity." We cannot look upon this as any great improvement upon Swedenborg's 'law of correspondences;' and, as the helpfulness of the book is entirely upon the religious side, we need not further notice a volume which attracted us by its title, but which we find to be morally edifying rather than scientifically satisfying.

BACTERIA, AND THE GERM-THEORY OF DISEASE.

On the relations of micro-organisms to disease. The Cartwright lectures, 1883. By WILLIAM T. BELFIELD, M.D. Chicago, Keener, 1883. 131 p., illustr. 24°.

Bacteria, and the germ-theory of disease. Eight lectures by Dr. H. GRADLE. Chicago, Keener, 1883. 4+219 p. 8°.

DR. BELFIELD'S little book is cheaply gotten up, and, beyond the possession of a few poor woodcuts, seems to be his original lectures, four in number, delivered before the Alumni association of the College of physicians and surgeons in New York in February, 1883. Even the phraseology of the lecture-room is apparently preserved throughout, and is sometimes decidedly more forcible than polite. Nevertheless, these four lectures, making in all about one hundred and thirty pages, give an admirable summary of the germ-theory of disease as it stood a year ago. Beginners or casual readers, perhaps, will not find the book diffuse enough; but pathologists and biologists will prize it for its lucidity, crispness, and keen discriminations.

After a careful perusal of these lectures, one finds himself impressed with the author's ability to go behind the returns, to draw the line between good and bad work, to catch or to predict the drift of things; and this is the peculiar merit of the book. Indignant at the attitude of some American physicians, Dr. Belfield treats their shallow objections with deserved contempt, sometimes even with harshness; but he preserves throughout the critical insight which might be expected of a follower of Tyndall and of Koch, and holds very fast indeed to that which is good.

To biologists it is of great interest to observe that pathologists are passing beyond the 'germ' theory, and are looking towards the unexplored country of unorganized ferments, ptomaines, etc., for the sources of disease, precisely as they themselves have gone thither to search for the causes of fermentation, of cellular digestion, and for many of the more intricate phenomena of physiology. The future of cellular biology seems to lie in these obscure ferments and ptomaines, affording a golden opportunity for the physiological chemist.

Dr. Belfield states his subject summarily as follows (p. 31):—

"Bacteria then, which, by virtue of their ubiquity, are in constant and frequently recurring contact with the animal body, are, like other minute bodies, organized and unorganized, frequently introduced into the body through solutions of continuity of the integuments, or through intact skin and mucous membranes, particularly by way of the lungs.

"The burning question in pathology to-day is, in what degree are the various species of bacteria, present in human tissues during certain morbid conditions, to be regarded as the cause of the morbid processes with which they are respectively associated?"

If we look for his answer, we find farther on that investigations carried on with rigid exactitude justify us in accepting provisionally the causal relation in some degree, but not so far as to exclude other like causes.

Illness may be caused by the not living products of putrefactions, as well as by the living organisms which abound in and probably produce putrefactions. But in the latter case the disease may be farther extended to fresh, healthy individuals by infection: in the former it cannot be. This points, in the one case, to a self-perpetuating cause; in the other, to one of limited powers. Moreover, good evidence exists that the boiled products of putrefaction which may produce illness owe their septic action to substances of obscure composition (ptomaines?) manufactured by the bacteria of putrefaction. This line of thought leads to the important conclusion (p. 42),—

"Hence we are logically driven, by all this work, to the belief that septicaemia implies the introduction into the animal either of living bacteria, or of a substance which has acquired noxious properties through previous vital activity of these organisms.

"More recent experiments have demonstrated, however, that the etiology of . . . septicaemia is by no means restricted to putrid infection. [For it was noticed by Schmidt that] the introduction or production in the blood of fibrin-ferment in considerable quantity produces effects identical with those of putrid infection—septicaemia."

It has since been asserted that pepsin and trypsin produce similar effects. If so, we may find eventually a cause behind the bacteria,—a fibrin-ferment-liberating cause (p. 44):—

"It would appear, although not for all cases demonstrated, that the . . . features common to the various forms of septicaemia are attributable to the rapid liberation of fibrin-ferment in the blood; and that any agent—organized or unorganized, putrid or fresh—capable of effecting such liberation may induce the disease."

So with the cause of suppuration. Belfield looks even beyond the germ-theory, beyond the bacteria involved, and with the eye of a biologist perceives that (p. 51)

"Suppuration must be regarded, then, as indicating the presence of an element foreign to the living animal cells; which may be induced directly [as by the introduction of a powerful irritant, e.g., Croton-oil], or indirectly as an incident in the life of various fungi [e.g., bacteria]. . . . Practically, we may regard acute suppuration as proof of the access of external irritant matter, organized or unorganized."

Antiseptic surgery is then easily defined. It is not a hissing spray, nor (p. 60)

"Simply a question as to the relative anti-bacterial properties of this, that, and the other so-called antiseptic agents. It is an attempt to prevent the entrance into, as well as the formation within, a wound of all substances, organized and unorganized, which can interfere with cell-nutrition."

Enough has been said to show the spirit of these lectures. They take a broad but thoughtful and critical view of the various questions involved, treating the scoffers who speak without knowledge as they richly deserve, and taking a rather conservative view of the work done in the direction of protective vaccination; displaying everywhere the thorough training of a German laboratory, and closing with a moral which all scientific men and all believers in rational medicine will do well to read, mark, and inwardly digest (p. 114):—

"And when we consider the problems already half solved, the questions to whose solution the way appears open through the same methods already successfully applied to anthrax and tuberculosis, we may hope for results to which present knowledge shall seem

a mere introduction. But these results can be secured only by earnest, skilful, continuous experimental investigation, which is practically impossible without pecuniary support. In France and Germany such support is liberally supplied by the government; in the United States, where human life is certainly as valuable as there; where live-stock interests are already greater than in these countries combined, and must multiply many fold in the immediate future; where a single infectious disease of cattle has caused the loss of \$20,000,000 in one year, and a single disease of hogs the destruction of \$30,000,000 in the same time; where infectious diseases are so prevalent among live stock that the fear of infection has closed European markets against American meat and cattle — the government of this great commonwealth, which advances enormous sums for local river and harbor improvements; which sends expensive commissions over the world to observe the transit of Venus or of the moon, or to find an open polar sea; and engages in other undertakings of purely scientific interest, has not yet made one judicious, systematic, liberally supported inquiry into the possibility of acquiring protection against pleuro-pneumonia, hog-cholera, and other devourers of the national wealth. A glance at the imperial German health bureau and its work during the last four years, and a mental comparison of the pecuniary resources of Germany with those of the United States, inspire the hope that we shall not

always lag so far behind in matters which appeal to the tenderest spot of the American anatomy — the pocket."

Dr. Gradle's book is made up of eight lectures delivered in Chicago, and is published on a more ambitious scale than are those of Dr. Belfield. For the beginner, or for one who is neither a pathologist, biologist, nor physiologist, this book is the more suitable. Its style is diffuse — not always, however, with a gain in perspicuity; and its index, its references to authorities, and its evident intention to give to all sides a fair showing, are features to be specially commended.

In these lectures we have, in fact, rather the report of the evidence than the judge's charge to the jury. We miss that critical and even judicial flavor which is so pleasant a feature of Dr. Belfield's book; and on that account we must consider the latter more suitable for the connoisseur; the former (Dr. Gradle's), for the beginner or the casual reader.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Yellowstone national park. — During the season of 1883 Mr. Arnold Hague began work in the Yellowstone national park, preliminary to a series of careful and systematic observations which are to be prosecuted in this field through a number of years. The geysers are to be made the subject of minute study; and the volcanic rocks, so abundant at numerous points in the park, will be examined in detail, not only as regards their geologic relations, but also in regard to their structure and composition. The field investigations in the park during the past season were confined mainly to the preliminary examinations necessary to determine what geologic and physical problems have to be solved, and to ascertain what thermal changes had taken place since the observations of 1878 recorded by Dr. Peale. Mr. Hague's party was constituted as follows: Mr. Arnold Hague, geologist in charge; Messrs. Joseph P. Iddings, W. H. Weed, George M. Wright, and C. D. Davis, assistant geologists; Dr. William Hallock, physicist; Mr. W. H. Jackson, photographer, with an assistant; Mr. Roland Holt, volunteer assistant; and cook, packers, etc.

Geologic work. — Mr. Hague took the field the latter part of July, outfitting at Bozeman, Montana. Work was begun in the park at Mammoth hot-springs early in August. From this point, slow marches were made to the upper geyser basin of Fire Hole River, to allow of a geologic reconnaissance of the route followed. At the latter locality a permanent camp was

established until the last of August. In the mean time a hurried trip was taken to the Shoshone geyser basin and the Heart-lake basin, for the purpose of comparing them with the geyser basins of the Fire Hole River, and to note what changes have occurred during the past five years. While on this trip, Mount Sheridan was ascended. Mr. Hague thinks that this mountain, from which a fine view of the surrounding country was obtained, is a volcanic crater, which has been so greatly modified by glacial action that its true origin has been obscured.

Camp was moved from the geyser basin to the Great Falls of the Yellowstone, Sept. 1, and kept there until the 19th. While at this point, the structure of the Mount Washburn was examined, and a trip made to the head waters of the Gardiner and Gibbon Rivers. The region of the Grand Cañon was also investigated, and the bottom reached at four different places. The Grand Cañon is an admirable place to study the decomposition of rhyolitic flows, the weathering of which has produced the brilliant coloring for which the cañon is so justly celebrated. A trip was also made from this camp to Steamboat Point, on Yellowstone Lake, from which point the ascent of Mount Chittenden was made. Mr. Hague considers this mountain one of the best points of observation within the limits of the park, and, after a trail has been built to it, thinks it will become one of the objective points of tourists who visit the lake. It surpasses Mount Washburn; as it gives a closer and more detailed view of the lake, and presents a magnificent panorama of the high mountain range on the east side of the park. The prospect is perhaps not so ex-

tensive as that seen from the summit of Mount Sheridan, but it is superior to it from the fact that the objects one wishes to see are nearer at hand. On the eastern slopes of the mountain is a remarkably fine glacial cañon.

From the Yellowstone Falls, camp was moved once more to the geyser basins, whence a trip was made to the western limits of the park, *viâ* the Madison plateau, returning through the Madison cañon, which exposes a fine section of the rhyolitic rocks that form the plateau.

The latter part of September camp was again established at the Mammoth hot-springs. The weather throughout the month had, with the exception of a few days in the latter part, been exceptionally fine for field-work; but October was ushered in with a severe snow-storm. Notwithstanding the inclemency of the weather, Messrs. Iddings and Wright undertook a reconnaissance of the region north of Mount Holmes, on the west side of the park, with a view to obtaining more accurate information as to the granitic area that lies just east of the rhyolitic flows that form the plateau of the park. The results, however, were meagre, on account of the severity of the storms and the depth of the snow.

At the same time Mr. Hague, accompanied by Mr. Weed, crossed the park in the opposite direction, to the head waters of Soda Butte Creek, with two objects in view, — 1°, to make a rapid geological reconnaissance across the northern part of the park to obtain definite personal knowledge of the Yellowstone Range; and, 2°, to visit the Clarke's Fork mines in order to learn their position in relation to the park boundaries, and to ascertain the extent to which mining operations have been pushed, and also to form an opinion as to the future prospects of the district as a mining-centre. The trip was a valuable one for general geologic purposes, and as suggesting plans for future operations, but for detailed work was not perfectly satisfactory, as the country was covered with snow, and snow-storms were of daily occurrence.

Although work was continued for some time longer in the vicinity of the Mammoth hot-springs, the weather remained so stormy that it was decided to pack the collections and leave the field; which was done the latter part of October, when the members of the party returned to the east.

Physical researches. — The geysers of the park suggest a number of physical questions which can be solved only after a complete and careful investigation, opportunities for which are nowhere presented with greater facilities than within the limits of the Yellowstone national park. The study of these questions was assigned to Dr. William Hallock, who steadily carried forward his observations in the Fire Hole geyser basins during August and September, and, since his return from the field, has been conducting a series of experiments in the laboratory at New Haven. When the results of these studies and experiments shall be made public, it will be seen that they are of the utmost scientific value.

Photographic work. — Mr. William H. Jack-

son, so well known from his photographic work in the park, while connected with Dr. Hayden's survey of the territories, accompanied Mr. Hague's party, and had a most successful season. His series of instantaneous views of the geysers in action will prove of great interest.

He obtained a large view (sixteen by twenty-two inches) of the lower falls of the Yellowstone, from a point at the bottom of the Grand Cañon just below where the water reaches the cañon, after its descent of more than three hundred feet. He also secured a fine large panoramic view from the summit of Mount Washburn.

A number of views of Yellowstone Lake were taken, that are particularly good.

Topographic work. — In order that the detailed geologic structure of the park may be correctly delineated, it was decided to begin topographic work for a detailed map, especially as the survey of the western and north-western portions of the park had never been completed. This work was intrusted to Mr. J. H. Renshawe, who undertook plane-table work on a scale of two inches to the mile. He outfitted his party at Bozeman, Montana, and began work in August in the West Gallatin Range, — a beautiful and interesting group of mountains, seldom or never visited by tourists, lying in the north-west corner of the park, between Gardiner's River and the West Gallatin River. The outlying spurs are cut and worn into most peculiar forms by glacial action. The survey of this area, comprising about four hundred square miles, occupied nearly a month, on account of the rugged character of the country and the detail with which the work was carried on. In the more level portions of the park it progressed more rapidly. Three hundred square miles of the plateau region lying more to the southward were surveyed during the latter part of the month. In September the work was extended still farther to the southward, until the heavy snows early in October compelled the postponement of further work to another season. The entire area surveyed in detail during the season is outlined as follows: on the north and west the limits are the boundaries of the park in those directions; on the east it is bounded approximately by the Norris wagon-road and Gardiner's River; and on the south by the lower geyser basin and the Fire Hole River. Besides the detailed work thus defined, meanders were run, and preliminary work extended, over all the usually travelled routes.

Upon the return of the party to Bozeman in October, a remeasurement, with compensated bars, was made of the base-line at that place, laid out in 1877 by the 'Geographical surveys west of the 100th meridian.' In this work Mr. Renshawe was rendered efficient service by Messrs. Chase and Garrett of the U. S. navy. The former is now at work on the computation and adjustment of these measurements.

Potsdam fauna at Saratoga, N.Y. — Mr. C. D. Walcott is closing up his work on the paleontology of the Eureka district, and preparing to take up the Potsdam fauna of the United States. From the past season's field-work, it was discovered that a massive

limestone, containing a typical Potsdam fauna, overlies the Potsdam sandstone of the New-York geologists in Saratoga county, N.Y. This limestone rests above the sandstone of Keesville, Whitehall, and Corinth, and is shown to be the true representative of the Potsdam sandstone of Wisconsin, as it contains *Lingula acuminate*, *Platyceras minutissima*, *Metoptoma cornutiforme*, *Crepicephalus* sp.?, *Lonchocephalus calciferous*, *Dicellosephalus Harti*, and *Ptychaspis speciosus*,—species all closely allied to those from Wisconsin. This limestone was referred to the calciferous formation originally; the great *Stromatopora*-like bodies of Hoyt's quarry, four miles west of Saratoga, occurring in it.

The contained fauna was partially described by Mr. Walcott in the thirty-second annual report of the New-York state museum of natural history, and referred to the calciferous formation.

The U. S. naval observatory.

Chronometers.—This department of the observatory is in charge of Lieut. E. K. Moore, assisted by Lieuts. E. C. Pendleton and U. R. Harris. There are at present in the chronometer-room 233 chronometers, of which 22 are ready for issue; 21 are on trial; 71 require repairs, and will be repaired as wanted for issue; and 119 are condemned to be used only as 'hacks.' A temperature-room has been constructed for the more perfect testing of chronometers, and the observatory is now prepared to test them at any temperature to which they will be subjected in their practical uses. A proposition was made to the chronometer-makers, each to place four chronometers at the observatory for a competitive trial, beginning Jan. 1, 1884, the bureau of navigation to purchase the four passing the best trials. This has been accepted by William Bond & Son, Boston, T. S. & J. D. Negus, John Bliss & Co., and D. Eggert's Sons, of New York. By this method of purchasing, the best American made chronometers will be obtained.

Transmission of time-signals.—This work is in charge of the officers having the care of the chronometers. The time continues to be sent over the wires of the Western union telegraph company, and time-balls to be dropped at New York and Washington, as stated in last report. This work is all done automatically by direct connection with the observatory clock. The fire-alarm bells continue to be struck, and the time to be given to the horological establishments of the city at six A.M., twelve M., and six P.M.

Nautical instruments.—This work is in charge of Lieut. W. E. Sewell. 121 sextants and octants have been received at the observatory for examination. 46 of this number have been found in good order. There are remaining on hand at the observatory 77 instruments, 10 of which may be made serviceable by repairs: the remainder have serious defects, which will render most of them worthless. The principal of these defects are bent arcs or bent pivots. Another very common defect is want of parallelism in the glasses. Few of the makers seem to have exercised much care in this respect. The sextants and octants made by Stackpole & Brother of New York are

superior to all others. The shades of 5 artificial horizons have been tested for parallelism of the glasses; and 3 were found defective, changing the direction of the rays from 1' to 2'.5. Two standard thermometers, made for the observatory by J. & H. J. Green of New York, have been tested for their freezing and boiling points, and their tubes calibrated. At no point was the error found to be greater than a fifteenth of a degree. Tables of corrections for 45 clinical thermometers have been made for the marine hospital service.

The library.—The library now contains nearly twelve thousand volumes. The accessions for the year aggregate sixteen hundred and two volumes, besides a large number of pamphlets. The annual volume of astronomical and meteorological observations for 1879 has been recently received from the public printer, and the copies are now being sent out. The demand for the volumes is very great, there being six hundred addresses on the regular list. The manuscript, consisting of eight hundred and seventy-five pages, for a complete catalogue of the books and pamphlets in the library, July 1, 1883, alphabetically arranged by authors and subjects, is now ready for printing.

Publications.—The printing of the volume for 1880 is nearly finished, while the manuscript for the volume for 1881 is nearly ready for the printer. The printing of the annual volume is falling behind from year to year; and, with the apparently necessary expenditure of the printing-fund at the disposal of the navy department, this seems inevitable. The department fund is usually exhausted by the last of April, and then two months' time is lost. If there were a fund at the sole disposal of the observatory, this difficulty could be overcome. The superintendent therefore urges that Congress be asked to appropriate seven thousand dollars annually for printing the observatory volumes, until the back work can be brought up as near as practicable to date.

U. S. astronomical expedition to Chile.—Professor William Harkness, assisted by Mr. Emil Wiessner, has made progress in reducing the zone observations made in Chile during the years 1850, 1851, 1852, by the expedition under the late Capt. J. M. Gilliss, U.S.N. The total number of stars is about seventeen thousand. On June 30, 1883, the appropriation from which Mr. Wiessner was paid became exhausted, and the work ceased. About a thousand dollars are needed to finish the preparation of the star catalogue from these zones, and it is hoped that Congress will grant that sum at the next session.

Increased estimates have been submitted for the coming year. The reasons for such increase are explained in each case in the letter accompanying the estimates. Experience suggests that the efficiency of the observatory should be increased by the appointment of a board of visitors, to consist of a limited number of distinguished astronomers, whose duty it would be annually to examine into the working of the observatory, and report to the secretary of the navy. They should have power to advise with the superintendent as to the character of the work to be done at the observatory.

NOTES AND NEWS.

THE death of Professor Ercolani on Nov. 16, 1883, at Bologna, inflicts a severe loss upon Italy; for he was distinguished both as a *savant* and a patriot. Count Giovanne Battista Ercolani was born in Bologna in 1819, and descended from an ancient patrician family. He was a favorite pupil of Antonio Alessandri, and early devoted himself to comparative anatomy and pathology. During the revolutionary movement, which swept over Europe in 1849, he was an ardent defender of Italian liberty, with the result of becoming an exile. He sought refuge in the near city of Turin, and there was appointed professor, afterwards director, of the veterinary school connected with the university. He remained in Turin until 1863, when he returned to Bologna to accept a similar position in the old university of that city. By his energy and influence, new buildings were erected, the school re-organized and greatly enlarged, and a valuable pathological museum established. For several years he held the position of rector of the university, and for a considerable period was permanent secretary of the Academy of science of the Institute of Bologna. Like Virchow, he was also a patriot. His reputation was not alone that of a teacher and *savant*; but his early career as a defender of popular rights made him a favorite with the citizens, and he was three times elected and served in the national parliament at Rome.

His numerous publications have contained the results of investigations made for the most part with the microscope, and have secured a wide reputation to his name. Most of his contributions first appeared in the memoirs of the Accademia di Bologna. His works show ability both as an observer and a draughtsman, and a tendency to touch upon general problems; but his arguments are not always clear, nor his observations sufficiently complete to establish his general theorems. He was an enthusiastic, careful, and industrious investigator, of whom Italy was justly proud.

His most extensive series of researches was upon the histology of the placenta, which led him to the conclusion that the lining membrane of the uterus degenerates, the placental membrane being a new formation, the lining being reformed afterwards from the uterine glands. This is not in accord with the views generally held at present. His single law of embryonic nutrition in vertebrates can hardly be considered novel, and is vague rather than profound. But the details recorded in these researches are of great value and interest. These memoirs, together with some additions supplied by the author, were translated into English, and published at Boston in 1880, under the direction of an enthusiastic admirer, Dr. H. O. Marcy.

His studies covered a wide range, — zoölogy, histology, and pathology were all included; but his most valuable work lay in the field of microscopical anatomy. His career has been justly admired, and his memory will long be cherished by his countrymen.

— The Government printing-office has just issued the third volume of the report of the tenth census. This relates to agriculture, and contains, besides the extended statistical tables concerning that industry, and discussion of them by the late superintendent, Gen. Walker, monographs upon cereal production, by William H. Brewer; flour-milling, by Knight Neftel; tobacco-culture, by J. B. Killebrew; manufacture and movement of tobacco, by J. R. Dodge; and meat-production, by Clarence Gordon.

Of the 1,182 pages embraced in this volume, 328 are devoted to the general statistical tables. These are exhaustive, and are very judiciously arranged for reference and use. A general summary, by states, of the principal statistics in 1880, 1870, 1860, and 1850, forms the first table. It treats of the number of farms; the area in farms, classifying the land as 'tilled,' 'permanent meadows, pastures,' etc., 'woodland,' and 'other unimproved' land; the value of farms, farming implements, and machinery; of live-stock, fences, fertilizers, and of all farm products; the number of the different classes of live-stock; the dairy products; cereal and fibre crops; sugar and molasses; hay, poultry, and eggs; apiarian products; rice, tobacco, Irish and sweet potatoes; orchard, market-garden, and forest products; wool, hops, broom corn, and pulse. Following this is a tabular discussion of the number and area of farms, and their form of tenure, by states and by counties. After this are placed county tables relating to the principal agricultural products. These tables are preceded by Gen. Walker's discussion (comprising 33 pages), in which are pointed out the limitations and qualifications of the statistics, and our progress in the different branches of the industry. It treats, in the author's well-known terse, incisive manner, upon the number and size of farms, their area and tenure, their value and that of farm products in total, and the principal agricultural productions severally.

The monograph by Professor Brewer upon the cereal crops is, like all work by this well-known authority, complete and exhaustive. He discusses the cereal product of this country as compared with that of other countries, especially with that of Europe; showing, that, with a surplus production in the United States of 650,000,000 bushels during the census year, there was a deficit in Europe of 380,000,000. The deficit in Great Britain was 280,000,000; in France, 170,000,000; and in Germany, 115,000,000 bushels. Following this discussion, the author naturally treats of the exports of cereals, noting their rapid increase in recent years. Their geographic and climatic distribution is next discussed, and is followed by a brief sketch of the principal classes of soils with relation to their applicability to cereal culture. Taking up the cereals severally, Professor Brewer discusses the product of each, its geographical and climatic distribution, its history, varieties, methods of culture, chemical composition, diseases, injurious weeds, and insects. The report closes with a brief history of American agriculture, and a discussion of the relations of this to other industries, and

of cereal culture to other branches of agriculture. The report is illustrated with sixteen double-page colored charts of the United States; showing the proportional extent of cereal culture, and the relative yield of cereal crops per acre, and per head of population.

The report upon flour-milling processes is one of a series upon power and machinery, which subject was under the general direction of Prof. W. P. Trowbridge of Columbia college, New York. It treats somewhat at length of the various milling processes and machinery, and is freely illustrated with outline plates.

Professor Killebrew's report upon the culture of tobacco occupies not less than 286 pages. Besides the tables of production, and a few pages descriptive of the principal types of tobacco, the report consists of descriptions of soils, climate, methods of culture, curing, and marketing of tobacco. Each state is treated separately and very fully, which necessarily produces a great deal of repetition, and thereby unnecessarily extends the report. The concluding chapter consists of a treatise upon the chemistry of American tobaccos, by Gideon E. Moore, Ph.D.

The manufacture of tobacco is treated by Mr. J. R. Dodge, now and formerly the statistician of the department of agriculture. Commencing with a history of tobacco-production in this country, he traces it up to the present time, sketching the origin and the present habitat of the different varieties. Proceeding then to the subject proper of the report, the author submits the statistics, and discusses them exhaustively. He next takes up the subjects of taxation and the revenue from this product, exports and imports, the commercial movement and prices, with which the report closes.

The report upon cattle, sheep, and swine, by Mr. Clarence Gordon, is supplementary to the statistics upon live-stock. This report relates to live-stock upon ranches as distinguished from that upon farms. The distinction is not an easy one to draw in all cases, the line between ranch and farm being by no means a plain one; and one cannot help questioning the utility of attempting to separate them. The report opens with a short chapter upon pasture and forage plants by Professor Brewer. The report proper follows, each state and territory being treated separately. The matter relating to each consists of an historical sketch, a description of the pasturage areas, and the management of the ranch business, both in cattle and sheep raising and in cattle-driving. The estimates of pasture-land are in most cases undoubtedly very much too great; as, for instance, that four-fifths (50,000,000 acres) of the area of Wyoming is available as pasture-land. The report closes with a summary of the exports of meat and live-stock, and tables of the numbers of live-stock on farms and ranches.

In its outward appearance, this volume, as well as those which have preceded it, is not by any means above criticism. The only part of the mechanical execution of these volumes which deserves commendation is the colored plates, which were presumably printed by the lithographers. It is greatly to be regretted that so important and valuable a series of

volumes should not be dressed in a garb in better keeping with their intrinsic merits.

— Dr. R. W. Shufeldt has asked authority of the surgeon-general of the army to compile an illustrated catalogue of the collection of comparative anatomy in the army medical museum, of which he has lately been placed in charge. Such a work as is intended, would be contained in a volume conformable in size with other illustrated catalogues of this institution that refer to the sections of surgery and medicine.

There are contained in the section in question upwards of three thousand specimens. These are chiefly osteological in character; and the classes of mammals, birds, reptiles, and fish, are pretty well represented. The general plan of this catalogue is to make it a complete work of reference to the collection. Each of the genera of all the vertebrate classes are to be awarded an illustration, and the text will present a concise account of the anatomy of the form treated. In every instance where it will be possible, the subject, be it an osteological one or a wet preparation of the soft parts, is to be chosen from the museum collection; so that any person using this catalogue will have the actual type before him, and the one that was selected to illustrate the text. Special attention is to be paid to the anatomy of such vertebrates as elucidate the principal questions in human physiology and anatomy, and good figures and illustrations of such forms will invariably be presented. Again: the vertebrates of our own country will be the subjects chosen in each case, as far as possible. By this means the student and anatomist may pursue his studies away from the museum after he has investigated all that is to be found there in his special line of research, and that, too, upon similar subjects. In short, it is evident that such a work will constitute a more or less exhaustive contribution to the literature of vertebrate anatomy, and be of special value to all scientific and professional men. The army medical museum contains within itself unusual facilities for the prosecution of such a work at comparatively little expense; since it has its own corps of workers, including photographer, artist, and others.

— Mr. Joseph Wharton of Philadelphia writes to the *Public ledger* of that city (Jan. 22) that he has found volcanic glassy dust in fresh, clean snow of recent fall. The snow, melted under cover in the porcelain vessel it was gathered in, showed at first no sediment; but after a time, and aided by a gentle rotatory movement which brought all to the deepest point, a slight deposit appeared. By pouring off most of the water, and evaporating the remainder, a little dry dust was obtained, which, even to the naked eye, showed, in the sunlight, tiny vitreous reflections. The dust weighed by estimate a hundredth of a grain, and showed under the microscope the characteristics of volcanic glass. It was partly irregular, flat, and blobby fragments, and partly filaments more or less contorted, which were sometimes attached in little wisps, and were mostly sprinkled with minute glass particles. Under a knife-edge, the filaments broke easily and cleanly. The irregular

fragments were of various sizes and shapes, mostly transparent, but, even when examined by strong transmitted light, showed no trace of crystalline structure. Their diameter was about that of single filaments of silk. No crystalline particle of pyroxene, or black crumb of augite, such as observers have found elsewhere in similar dust, was present; nor did a strong magnet stir any particles of magnetic oxide of iron, though they also have been found in other volcanic dust. It may fairly be assumed that those heavier minerals, if at first mingled with the volcanic glass, had been already deposited during the long voyage through more than ten thousand miles of space and more than four months of time, while the tenuity of the intrinsically lighter glass threads (the Pele's hair of Mauna Loa) enabled them to float farther from the point of eruption.

—The maps recently published by the Northern transcontinental survey, the discontinuance of which we regret, include the Crazy Mountains and Judith Basin in Montana, and the Yakima and Colville regions in Washington Territory, — a total area of about twenty thousand square miles, on a scale of two miles to an inch, with contours every two hundred feet. One has only to look at the best previous compilations of these districts to see the need and superiority of the new work. With this excellent basis, Prof. E. W. Hilgard of the University of California, in charge of studies of soils, has prepared three maps, four miles to an inch, printed in colors, of the Yakima and Colville districts, showing the characteristics and possibilities of the surface in much detail. Mr. T. S. Brandegee, working under the direction of Prof. C. S. Sargent of Harvard university, in charge of forestry, has also completed a map of the Yakima district, showing the distribution of the valuable trees in much detail: a regrettably large area is marked as burnt.

These maps form but a small share of the material now collected: the greater part is not yet prepared for publication. In Mr. Pumpelly's first annual report, mention is made of the discovery, by Mr. George H. Eldridge, of valuable coal close to the line of the Northern Pacific railroad, near Bozeman, Montana; and of explorations of the coal-fields west of the Cascade Range by Mr. Bailey Willis. Studies of climate and rivers were undertaken by Prof. E. S. Holden of the Washburn observatory, — studies of the utmost importance in the interior region, where cultivation, unless on the lowest bottom-lands, is impossible without irrigation in the drier summer months. Much material has been brought together by Mr. W. M. Canby concerning the distribution and relative abundance of the various forage-plants on which the stock-raising interests depend. It is sincerely to be hoped that the results of these practical studies may be brought to light, together with the scientific information gathered during the two seasons during which the survey has been in operation.

— *Nature* reports that the French Société des électriciens has completed its organization, and has been divided into six sections, — Theoretical electricity,

M. Marie Davy, president; Dynamo-electrical machinery, transmission of force to a distance, distribution of energy, M. Tresca, president; Electric lighting, M. du Moncel, president; Telegraphy and telephony, M. Blavier, president; Electro-chemistry and electrotherapy, M. Jamin, president.

—At the last general meeting of the Société de géographie, M. de Lesseps announced his conclusions on the subject of the Suez Canal. A project had been submitted to the English government; and, if a favorable response be not received, the canal company will proceed to carry out its own plans. He claimed that no one else had a right to make a canal by the side of the present one, and that this occupies the only feasible route. To the west the topography presents obstacles. To the east, a new canal would destroy the system of irrigation upon which the wealth of the country depends. All that is needed is to enlarge the present canal. When this was projected, the most eminent engineers of all countries decided on a canal with forty-four metres width at its maximum depth; but, owing to great expense and opposition encountered, the company contented themselves with a width in this part of twenty-two metres, which completely satisfied the needs of the commercial world of that day. Twenty-five years ago the increase of steam-navigation was not dreamed of. In 1830, of five hundred vessels composing the expedition to Algeria in the port of Toulon, there was not one steamer. In 1882 seven millions of steam tonnage passed through the canal, and only one sailing-vessel of seventy-five tons. The principal question to be determined at present, is, whether the enlarged canal shall consist of two waterways with an embankment between them, or whether the breadth of the present waterway should be extended to forty-four metres at the bottom and a hundred and twenty at the surface of the water. This would be decided by the engineers consulted, though the speaker was in favor of the latter plan, as swift vessels could then pass slow ones. The embankments of the canal are a relic of the days when vessels were towed. He saw no reason why the enlarged canal should have any embankments purposely constructed. The dredgings, which will be much less considerable than in the original work, can be dumped by the side of the canal, and thence spread out without maintaining a bank of any kind. This, at least, was M. de Lesseps's opinion.

—Prof. F. H. Snow, of the University of Kansas, reports that the chief characteristics of the weather of 1883, from observations taken at Lawrence, were the low mean temperature of all its months except April, November, and December; the unusually long period of immunity from severe frost; the large and well distributed rainfall; the slight preponderance of northerly over southerly winds; the high average wind velocity; the very high mean barometer, surpassing that of any previous year of our sixteen years' record; and the remarkably brilliant and long-continued orange and crimson sunrise and sunset glow of the last five weeks of the year.